PREFACE.

This handbook is a compilation of what others have learned and written; it has no pretension to be more. What was scattered has been sought to be brought together. In all cases authorities were intended to be given; if the intention is not always carried out, the omission is accidental. The ordinary classification of fish, in some respects, has been ignored, the manual being intended for the use of the general and not the scientific reader. The nomenclature of icthyologists conveys no meaning to the bulk of mankind. What information is here gathered is put in a simple form, for simple people to easily find.

The scientific details given are to enable those desirous of so doing to fix the genus and species to which any particular fish belongs. A List of the Classified Fishes of New Zealand will be found at the end of the book.

The information concerning the preparing of fish for sale, cured, canned, or otherwise, has been made as complete as possible. Some of the processes, regarded as trade secrets, were difficult to obtain.

The supplementary chapters on seals and whales are as full as the materials the compiler could gather afforded. Free-trade in sealing and whaling in our waters almost destroyed both the industries before their histories were written.

The compiler desires to express his grateful thanks to Mr. T. F. Cheeseman, F.L.S., the Curator of the Auckland Museum, for the valuable aid he has given him while engaged in the compilation.

HANDBOOK

OF THE

FISHES OF NEW ZEALAND.

WHEN any person attempts to gather information about New Zealand fish, he soon becomes aware how little is known on the subject, save in a general kind of way. What is known has been in the main from the action of the fish themselves. They have almost come on shore and provoked inquiry. Cook, in his first voyage, got in barter John Dorys from the Natives on the East Coast, but some 100 years later the capture of one off Kapiti Island was regarded as a notable event. Something similar took place with the sprat and other fishes. Inquiries were set afoot in 1868 and 1869 as to what fish were common to New Zealand waters, and a Fisheries Commission was appointed to gather information; but all that was learned was what fishmongers and fishermen could tell, and nothing was definitely gleaned save what Dr. Hector and a few others gathered and subsequently published. No other result could have been expected from the Commission, as no means were provided by the Government for its making inquiry, nor were any funds at its disposal. When any one wanted, at that date, to obtain information about our fish, he had to provide it at his own cost; and, parliamentary inquiries notwithstanding, the same lack of information almost prevails to the present day. This ignorance about the fish of New Zealand can be excused, from the fact that we are mainly a people in a new land, having almost everything to learn, and nearly as much to forget, before we are apt for instruction. We expected, in some unknown way, our fisheries to develop themselves, after the manner of alluvial gold fields; to be opened up and made profitable, as would a claim that would pay an ounce or two to the ton; to be the result of individual effort and enterprise; and, if combination arose, to let it struggle unaided and uncountenanced, save by an unsubstantial patronage confined to kind wishes and hopes for success.

This lack of precise information is not, however, confined to ourselves. Last year the Hon. Edward Majoribanks, M.P., wrote, in the *Fortnightly Review*, of November, under the heading "Our Sea Fishermen": "The object of this article is to touch briefly upon those points which have been prominently brought forward in certain parliamentary inquiries, on which it has been my lot to serve during the past five years, and which, I insist, it is the duty of the Government to deal with. The first of these points is the terrible want of trustworthy information that meets the inquirer at every turn on all matters relating to fish and fisheries. This want of information may be divided under two heads: (*a*) Absence of statistics of fish caught, and of the different grounds, seasons, and conditions on and at which they are caught; and (*b*) absence of accurate and scientific knowledge as to the habits, food, and spawning of the various kinds of fishes which inhabit our waters." If this reproach can be hurled against Great Britain, our ignorance may certainly be regarded in a more excusable light.

The want felt by the Royal Commission on Fisheries of Tasmania may be said to be ours: "To learn accurately of each species—its migratory habits; its seasons; the time, mode, and place of spawning; the nursing grounds of the young fry; their natural enemies; their feeding grounds in the adult stage; their vitality in imprisonment, as in the wells of boats, etc. For if we be ignorant of these matters, we cannot hope that good practical results will follow."

To make such investigations, Mr. Lankester writes, continuous residence for weeks and months at a time by the seashore is necessary. In France, Holland, Italy, and the United States, seaside laboratories have been constructed, which are provided with working tables, glass apparatus, aquariums, etc., and a staff of attendants and fishermen, to which naturalists can resort who desire to carry on investigations upon the life-history of marine organisms.

In the matter contained in the following pages there has been no attempt made to acquire fresh information, but to bring together from many sources that which has been already got, indicating generally from whence the details compiled have been obtained. What may be called the base of the compilation is Dr. Hector's pamphlet on the "Edible Fishes of New Zealand" (which may be said to be here reprinted), supplemented by descriptive details from Captain Hutton's catalogue, with materials found in the *Transactions of the New Zealand Institute*, and the parliamentary papers; while to Captain Fairchild and others direct acknowledgment is given for the information they supply. The Fisheries Exhibition Literature has been ransacked, and laid under heavy contribution as to the habits of fish that are

common to both hemispheres, their uses, and means of capture. The value of the New Zealand fisheries was seen long since, and by none more clearly than by John Munro, Esq., M.H.R., who wrote a memorandum on "Coast Fisheries" to the Joint Committee on "Colonial Industries" in 1871. In this memorandum he said: "I don't know a better project in New Zealand than a fishing-station, if judiciously managed; and, were it not for my time of life, and the interest I had in the people who came with me to the country—seeing them, with myself, adrift and astray in a new and distracted colony, without land to settle on—old as I was, in all probability I would have set a fishery a-going. For I do not only believe, but I know, that there is an inexhaustible source of national wealth swarming unmolested round these islands, and on sunken rocks not yet discovered, that will yet be a profitable resource to the laborious fisherman, and contribute largely to the aggregate prosperity of the country. In my own humble view, our present mineral wealth is nothing now to what it will be in the time to come, yet I believe that the fisheries of this country will surpass it in wealth, permanency, and stability." All that has been learned of our fisheries since that declaration has only confirmed the prescience it contained In like manner Mr. McLeod, giving evidence before the Provincial Council of Auckland, said: "I was engaged for seventeen years in the North American fisheries, but I find that New Zealand possesses better fishing grounds than either America or Newfoundland."

The hapuku is a better fish than the cod; our marketable fishes are more numerous than the varieties exported from Newfoundland; our coast line is nearly 5,300 miles in length; while fishing in New Zealand—off the North Island—is practicable at least two days to one to what it is on the North American coast. And here it may be said that the object of this compilation is to draw attention to the commercial inducements the fish and the fisheries of New Zealand offer.

The value and production of the fisheries of the world can only be approximately estimated even by the best informed. There are areas of sea and estuary extremely fertile in food production. The Dogger Bank covers some 4,000,000 acres—the provincial district of Hawke's Bay is less than 3,000,000 acres—yet the more liberal computation would assess the yield of fish from the Dogger Bank at £5,000,000 a year. British fishermen are asserted to draw at least £10,000,000 sterling annually from the seas surrounding the British Islands. The fisheries of the United States follow with a take worth £8,600,000; and Russia comes (these figures are for 1883) a good third with a yield of £5,250,000. These three nations occupy the foremost place in the fishing communities of the world; and in regard to the two latter

the language of M. de Tocqueville has been suitably applied: "They have grown up unnoticed . . . . and the world learned their existence and their greatness almost at the same time."

The official report on the International Fisheries Exhibition, from whence these details are mainly gathered, says: "With the exception of these three great countries, no nation in the world draws £5,000,000 a year from its fisheries and kindred industries. Canada probably draws £4,000,000; France, £3,500,000; Italy, £1,600,000; Spain, £1,400,000; Norway, £1,300,000; Newfoundland, £1,250,000; and Holland, £1,000,000, from fishing. It may be doubted whether any other nation or colony—unless China and the East Indies be exceptions—draws £1,000,000 a year from the waters of the ocean.

Oysters are said to be the most valuable product drawn from the great deep—as in all probability was another mollusc, from which the Phœnicians extracted their purple dye in the days when Solomon built his temple. If oysters are the most valuable product drawn from the sea, the report continues: "Cod are the most valuable fish drawn from its waters. The cod caught by American, Canadian, Newfoundland, French, Dutch, and Norwegian fishermen, are worth £4,200,000 a year." The herring fishery ranks next in importance. "While salmon though they do not probably produce so much money to the fishermen, certainly do not produce so much food for the public as the more homely cod." There was, therefore, truth as well as wit in the saying in the play—

> She that in wisdom never was so frail
> To change the cod's head for the salmon's tail.

A paragraph has gone round the newspapers of the world which naturally fits into this place. It was taken from the same source as the above details. "There are not far short of 160,000 vessels engaged in Europe and North America in fishing. Between 600,000 and 700,000 men are employed in this industry, and the total annual product of fish is not far short of 1,500,000 tons. Few people realise the meaning of these latter figures. A ton of fish is equal in weight to about twenty-eight sheep; and hence, if Mulhall's estimate is approximately correct, a year's fish supply for ten European countries, included in this estimate, and the United States and Canada, might be represented by 42,000,000 sheep."

Professor Goode, in his review of the fishery industries of the United States and the work of the United States Fish Commission, says, among many other valuable things: "One of the important features of the work has been the preparation of life

histories of the principal fishes, great quantities of material having been accumulated relating almost to every species. A portion of this has been published; biographical monographs having been published on the blue-fish, the scup, the menhaden, the salmon, the white-fish, the shad, the mackerel, the sword-fish, and others are being printed. Similar monographs upon the lobster, oyster, and other invertebrata are also ready." It appears to the compiler that in this direction the New Zealand Government could profitably follow that of the United States.

The arrangement of the information in this compilation is alphabetical: thus, any one wanting to find what is said about gurnard would turn up *G*, and look for gurnard in its proper place. Should patiki be wanted, reference would lead to patiki, and thence to flat-fish, and so on in other cases. The names by which particular fish are most commonly known are those used with their scientific designation annexed, to ensure precision. It is sought by this means to avoid reference to an index as much as possible. At the conclusion of the first section of the handbook will be found a letter from Mr. McKenzie to Sir Julius Vogel, which it has been considered expedient to publish over the writer's signature.

Dr. Hector, last year, writing on the food fishes of New Zealand, said: "It is necessary to state that our knowledge of the fishes around the New Zealand coast is very imperfect, as our opportunities for observation have hitherto been confined to the shallow waters of harbours, or to the vicinity of rocky promontories. Of the deep-sea fish, and those which frequent banks and shoals at a distance from the coast, little has been ascertained, except from specimens which have been cast on the shore during heavy storms. The distribution of sea fish is effected chiefly by causes regulating the distribution of their favourite kinds of food. Thus, swarms of medusæ, mollusca, and larval crustacea crowd the seas round our coast during the summer months, attracting shoals of small fishes, which again are pursued by those of predacious habits, so that many kinds visit our shores at that season which are absent during the colder months of the year. Many valuable fishes, which from their occurrence in large migratory shoals are of greatest commercial importance, appear to live chiefly on those forms of marine life which have only an ephemeral existence, dependent on the character of the coastal currents. In the Northern Hemisphere it has been ascertained that the herring is restricted to those parts of the sea in which the temperature is never less than 54° nor higher than 58° Fahr., a range so limited that it probably relates to the existence of some delicate marine animal that forms the food of the fish. The study of the ocean

currents that sweep our coasts is therefore invested with great practical interest, as it will enable us to infer, from the experience gained in other parts of the world, the character of the marine life which stocks our seas, and thus enable fishing communities to be located in the most advantageous positions. The establishment of marine observatories, for studying the habits, development, and life-history of fishes useful for food supply, and of the lower forms of life upon which they in turn subsist, has been effected in many parts of the coasts of Europe and America, and also near Sydney, with most beneficial results; and any vigorous effort to regulate the existing fisheries of our coasts, or to introduce new species into the fauna, should be preceded by the establishment of similiar observatories on the New Zealand coast. From the data respecting the direction and average temperature of the sea round the coast of New Zealand, obtained from a series of observations, it appears that the coldest part of the sea is on the south-east coast of Otago, where the temperature of the surface-water ranges from 48° in winter to 57° in summer, corresponding averages for the atmosphere being 43° to 58°. The cold current thus indicated, which probably exercises a good effect on the quality of the fish, besides limiting the range of a few species, appears to extend its influence up the East Coast as far as Cook Strait; but on the west side of the Islands the average winter temperature of the sea was found to be decidedly higher, and equal to that experienced 6° of latitude farther to the north on the East Coast. In the extreme south the summer temperature does not, however, rise to a corresponding extent; but on the whole there is evidence that the warm equatorial current which is known to skirt the east coast of Australia, and has been. by Commodore Wilkes, likened to a southern counterpart of the Gulf Stream of the Atlantic, must be directed against the west coast of New Zealand, tending to equalize the temperature in that region. These ocean currents are now considered to result from long continuance of winds in one direction; and, in support of this view, we find that there have been several instances of fishes that belong to the Australian coast, and turtles, accompanying areas of drift seaweed, stranding in Cook Strait, and even on Stewart Island. On the north-east coast of New Zealand, as far south as the Bay of Plenty, there are further evidences of a current from the north to be found in the abundance of the flying-fish, the occasional visits of the true nautilus, and also of the argonaut or paper-nautilus. Gigantic pods of a leguminous plant that grows on the Fijis are also frequently cast up in the same way that West Indian seeds are thrown on the coast of Scotland by the Gulf Stream. This current, although it reaches New Zealand, does not, however, appear to pass down the east coast, as there is a steady drift from New Zealand to the eastward,

by which sawn logs, telegraph poles, and, on one occasion, on the authority of Mr. H. Travers, a number of totara sleepers that broke adrift from Pigeon Bay during the earthquake wave in 1868, were cast up on the Chatham Islands, which lie 450 miles east of Bank's Peninsula. These islands appear, as it were, to lie in an eddy to the leeward of New Zealand, as a much larger proportion of pumice-stone and drift-wood, floating to the eastward, finds a resting place there than the relative size of the two groups of islands would lead us to expect. It is, most probably, this tropical current sweeping from the East Cape to the Chatham Islands that gives rise to what the whalers call the "Banks," which is a favourite feeding-ground for the sperm whale. The depth of water in this area has not yet been explored, and it is considered doubtful if there is really a shallow bank, or anything more than a tract of ocean which is unusually rich in marine life. It is important to note that, according to the most recent discoveries, it appears that the eggs of many species of marine fish rise to the surface of the sea and float about while hatching in the warmer surface-water, so that the set of ocean currents towards or away from an island like New Zealand might seriously interfere with the acclimatisation of some kinds of food-fish. If we compare the assemblage of fishes which we find in the New Zealand seas with those in the European region, we find that, on the whole, they resemble those which are found on the coast between Madeira and the Bay of Biscay more than those which are caught about the north of Scotland. If we contrast the thirty-three sea fishes that are fit to be used as food in New Zealand, we have among the constant residents on all parts of our coast the hapuka, tarakihi, trevalli, moki, aua, rock-cod, wrasse, and patiki; and while the schnapper, mullet, and gurnard are only met with in the North, the trumpeter, butter-fish, and the red-cod are chiefly abundant in the South. But, with the exception of the patiki or flounder and the red-cod, none of these are representatives of fishes that are common even in the south of Britain, while from the more northern seas similar fishes are altogether absent. In addition to those which remain throughout the year, a very large number of the fishes on the New Zealand coast, owing to its geographical position, are pelagic in their habits, and roam over a wide range of ocean, visiting our shores only irregularly in pursuit of food. Of the edible fishes of this class, by far the largest number are visitors from warmer latitudes, such as the frost-fish, barracouda, horse-mackerel, king-fish, Dory, warehou, mackerel, and gar-fish, while only the ling, hake, haddock, and a few other rare fishes, which are worthless as food, are among those of more southern types which reach the New Zealand coast in their migrations. There is, however, no reason to complain of any want of useful variety in the New Zealand fishes as compared with

Britain, for we find that, out of 208 species of fishes enumerated as occurring in the Britain seas, including many which are extremely rare or only occasional visitors, only forty are considered to have a marketable value. In New Zealand, notwithstanding our very imperfect knowledge, especially with regard to the gregarious tribes, which there is reason to believe inhabit shoals at some distance from land, out of 130 sea fishes, of which thirty are only known to us by report, we have nearly as many varieties used for food as are brought to market in the British Islands."

SALT WATER FISHES.

ANCHOVY *(Engraulis encrasicholus).*

Length four times that of the head, or seven times the height of the body; snout pointed, projecting much beyond the lower jaw; maxillary very finely toothed; origin of the dorsal fin midway between the end of the snout and the root of the caudal; anal commencing at some distance behind the dorsal.

Sides and abdomen silvery, separated from the dark colouration of the back by a blackish stripe.

Exceedingly abundant in Victorian waters, the anchovy is found in New Zealand, and specimens, in 1873, were exhibited by Mr. C. O. Davis at the Auckland Institute. It was found at the mouth of the River Thames, and called by the Natives there korowhawha.

Gregarious in habit, at certain seasons of the year it ascends rivers almost as far as the tide flows; and though seldom coming close to shore, quantities hang about the coast. Among English fishermen anchovies are mostly taken in drift nets, or in seines, by accident as it were, their size enabling them to escape through the mesh of most nets, although more than 150,000 are reported to have been once caught in a pilchard seine in Mevagissey Bay, and used for manure. In the Mediterranean, Mr. Day says they are fished for from May to July. "Dark nights are selected, and each boat carries a torch to attract the fish, or a light is floated for this purpose. The shoals are encircled by small-meshed nets, while the fishermen splash the water and endeavour to frighten the shoals, which rush headlong into the meshes of the net." When caught, they are prepared by drawing off the head of the fish and removing the viscera. They are not washed or wiped, but packed into small casks of 5lb. to 20lb. weight, in layers alternately with a mixture of 2 ounces of Prunella Salts (saltpetre, deprived of its water of crystallisation by heat). They should be well pressed down, and the air excluded. Anchovy sauce is made by bruising the fish, and simmering it over a slow fire; a little vinegar and flour are added, and the fish dissolves in the process.

It seldom exceeds 6½ inches in length.

"Examples of the anchovy," Mr. Kent writes, "the first acclimatised in this country were successfully imported by the writer in the year 1875, from Morecambe Bay, to the tanks of the Manchester Aquarium."

An idea of the extent of the Italian anchovy industry may be gathered from the fact that at Palermo alone the annual take is some 400 tons.

Although the anchovy of commerce is mainly supplied from the Mediterranean, its preparation may be stated to have recently become a Cornish industry; while imitations are manufactured and canned in America in large quantities, and, it is said, "so like those imported that only experts can recognize them." It may be remembered that Venier, in his "*Via Recta ad Vitam Longam*," published in 1650, says: "Anchovas, the famous meal of drunkards and of them who desire their drink to delight their palates. They are used as sauce with meats, as with mutton, etc., and is in great esteem with them who affect sauce and meats of strange relish and taste. They nourish nothing at all but naughty choleric blood. They are chiefly profitable to the vinters."

The anchovy is found in great quantities in the Tasmanian waters, and the Royal Commissioners express surprise "That no efforts have been made locally to utilise this valuable fish."

There was some singular evidence given, in the Fisheries Inquiry Commission of New South Wales, on anchovies, by Mr. John De Groot Pzn, Dutch Representative for the Sydney International Exhibition. He said:—

"A very important and interesting fishery is that of the anchovy. The principal town where that is carried on is Bergen-op-Zoom—that is, in Noord-Brabant, in Holland. They catch the fish in the Schelde, forming the boundary between Belgium and Holland. This is a very large fishery, and the fish are a great luxury. It is in the hands of three or four big men in Holland, who hold the fisheries there, and they make an enormous lot of money. The beautiful flavour is owing to the fish being caught, cured, and put in salt like the Dutch herrings. The consequence of that, you can see, is this: that I have here anchovies put into a glass bottle two years ago, and they came out here in the most splendid manner, so that the judges have given for the sample the very highest reward, and a special mention that nothing of the kind was ever before seen in the colony. The peculiarity of the anchovy is that they go in large barrels, just as the herrings, and are salted and sent in a packed state to England to make your

beautiful anchovy sauce. When the anchovy is cured in salt, and you let it lie quiet for two or three years, and then you open the barrel, you find no fish, but a white chalky substance; the fish decomposes quite into a white and thick liquid, which fetches an enormous price. They send orders from England sometimes for it and cannot get it, but it goes to England to make the sauce."

PRESIDENT: "This rotten stuff?"

"Yes; Crosse and Blackwell's, Lea and Perrin's. I have been in their establishments, and I have said: 'Show me anchovies; where are the barrels? Let me look at your *magasin*.' I saw the barrels, and saw the Dutch brand on them. But I said 'Do you call that anchovy?' and he said, significantly, 'Everybody does not come here.' That is how they make their anchovy sauce; but is it not a peculiar thing that the salt fish decomposes into a white thick liquid? I like to eat it on bread. The difference between the Norwegian anchovy and the Dutch anchovy cured is that the Dutch anchovies are put simply in salt, whereas the Norwegians put theirs with vegetable and pepper and other hot stuff, and really spoil them. There is a great demand for them, but one who prefers the pure anchovy does not like them."

ARARA (*see* TREVALLI).

AUA (*see* MAKAWHITI).

BARRACOUDA (*Thyrsites atun*).

Total length four and a-half times that of the head, or eight times the height of the body; three pairs of strong teeth in the upper jaw; the lateral line descends abruptly below the posterior part of the spinous dorsal.

Above plumbeous, whitish below.

Dr. Hector describes barracouda as a very common fish, well known throughout the colonies as the barracouda, which name is no doubt borrowed from a fish of a similar shape, the barracouda pike of the tropical parts of the Atlantic. This fish is a favourite with the Maoris, who call it the manga, or maka. They are obtained at all seasons, but abound in the spring and autumn, and are easily caught with a short piece of red wood having a

nail driven through it for a hook. This rude tackle is passed rapidly through the water alongside the canoe or boat by a short line and rod, and is eagerly grasped by the fish, which is then jerked inboard. The usual length of the barracouda is 3 feet, and its weight 5lb. Its flesh is white and flaky, and by some is thought to resemble that of the cod. In the early days of the Otago settlement, when the colonists depended solely on the Maoris for the supply of fish, it was very extensively used. It dries well, and is thus preserved in large quantities by the Natives. When pickled and smoked it is excellent food, and preferable even to fresh fish. Dried barracouda—or snook, as it is called—is imported into the Mauritius and Batavia as a regular article of commerce, being worth over £17 per ton.

Snook were very plentiful at the Cape of Good Hope years since, when a score or twenty-five could be bought for the price now paid for one. The late Mr. J. T. Thompson, who watched the Dunedin fish market for three years, and to whom we are more indebted for precise information as to our edible fish seasons than to any other, found the barracouda offering for sale in Dunedin 112 days in the year, on the average for three years; and from the same authority we learn that the season of its abundance in Otago ranges from October to June.

It is seldom seen offering for sale in the north of the Colony, though found in abundance from Cape Colville to the Barrier, and round towards Tairua Bay. The large shoals found in other parts of the seaboards are said to be infrequent in the Canterbury waters. Mr. John McKenzie, in his letter to Sir Julius Vogel, of March, 1885, describing what he saw in the southern part of his journey, says: "And here (Chasland's Mistake) I began to meet with the barracouda in large numbers, and found them all the way northwards to off Oamaru; but off Cape Saunders and Otago Heads seems to be a central gathering-ground for countless millions of these fish for several months in the year. Two men fishing, and one man rowing the boat, will often catch from thirty to forty dozen fish in two or three hours."

Mr. Johnston, of Tasmania, says: "They prey upon the shoals of young or small fry which swim near the surface, principally sprats, anchovies, etc., although they are so swift and rapacious that even the English sea trout and other large fish fall a ready prey to them. They are caught in Tasmania ten months in the year; from November to October."

Twenty-four dozen fish, the Tasmanians say, weigh about a ton. They split and send to the Melbourne market some 800 or 1000 dozen per annum; but their market is restricted as well as ours, although 3s. per dozen the fishermen consider a good price. They are sometimes caught full of mature roe, and as small as a gar-fish.

BLACK PERCH (*see* PERCH).

BLUE COD (*see* COD).

BOAR FISH (*Cyttus Australis*).

Length equal to two and four-fifths the length of the head, or one and three-eighths the height of the body; length of the head three and two-thirds the diameter of the eye; profile of snout straight; scales small, ctenoid; lateral line more or less sinuated, following the curve of the back; dorsal fins stout, produced into long filaments (generally broken off); ventral rays not produced, one-fourth length of the head, when closed covering the vent; anal spines very short and stout.

Silvery, pale purple above; no lateral black spot.

The term boarfish has been applied to a fish of which several specimens were cast up on the shores of Cook Strait. They resemble the Dory somewhat in form and size, but are easily distinguished by the rough skin and the absence of the round black spot on the side. They are reported to be inferior to the Dory as food; very seldom seen in the Auckland market; but caught occasionally at the Thames.

The Tasmanian Commissioners say they are abundant during the month of April in the estuaries of the Derwent and Tamar, but although fine edible fish, are rarely captured, probably owing to the fishermen lacking the proper kind of net. They add, in another place: "If knowledge of its habits were more extended, the success of the trawl as a mode of capture might yet be realised to advantage." A fisherman of 18 years' experience stated before the Commissioners that "he had only caught a few dozen bastard John Dorys (*Cyttus Australis*) in the whole course of his fishing." In the classification of fish by the Commissioners, the boar-fish is included among the groups that frequent estuaries and inlets around the coast from one to three fathoms, and fishing banks from three to eight fathoms, in the neighbourhood of still deeper water.

BRILL (*see* FLAT FISH).

BUTTER FISH (*Coridodax pullus*).

Length four and two-thirds that of the head, or three and three-fifths that of the body; length of the head three and a-half times that of the snout.

Purplish grey, lighter below, often with a broad pale band on each side from the mouth to the caudal; mouth præoperculum; anal and dorsal fins variegated with bright French blue; belly and under the pectorals sparingly variegated with yellow; lips purplish red; ventrals and pectorals variegated with the same colour.

Three series of small scales behind the orbit; præoperculum entire; caudal square; dorsal and anal getting larger posteriorly; ventrals a little behind the pectorals; mouth small, maxillary not reaching to the anterior margin of the eye.

Above dark brown, with greyish streaks; belly grey, marbled with brown; fins dark brown, spotted with greenish grey; iris orange.

Known by many as the kelp-fish, and by the fishermen in some places as the butter-fish. Dr. Knox, in the *Transactions of the New Zealand Institute*, gives the following interesting details of the marare of the Natives: "On the 2nd August, 1870, a large quantity of the kelp-fish were offered for sale in and about Wellington, and, though by no means prepossessing in external appearance, being of a dingy-black colour, and covered with a slimy mucus, I found that the fish frequent Cook Strait, more especially off and around the island of Mana. They are very rarely taken with bait, but are fished for by means of a net in the form of a bag with a hoop round the mouth, and secured with a rope to a branch of the kelp, which grows of vast dimensions around the island of Mana. The net is set among the kelp, where the rise and fall of the tide produces a kind of free run, which the fishermen avail themselves of in setting their net, and, upon returning, they find it full of the fish of all sizes. The kelp in this locality may be viewed as a vast submerged forest, growing from stems two or more feet in circumference, fixed to the bottom of the sea, and is often used by the Cook Strait fishermen and captains of small coasting vessels to secure their craft in a gale of wind." The weight of the fish, Dr. Hector says, "Is from 4lb. to 5lb., and the largest specimens are above 20 inches long." He adds, notwithstanding its forbidding appearance, "It is very good food, the flesh being exceedingly short in the grain, and well flavoured, without being rich, every part of the fish being singularly deficient in oil." The bones, Dr. Knox says, present "A bright or bluish green colour, which is so permanent as to resist the process of prolonged maceration, and subsequent bleaching, and even boiling." Large quantities are caught in Foveaux Strait, and sold in Invercargill. They are found in places along the coasts where kelp grows. The Dunedin supply, which is rare, comes from the Moeraki district, the scarcity being without doubt from their being only accidentally ... t. They are rare also in the Christchurch market, a few ... ing for sale in the moki season.

Found in Preservation Inlet, Chalky and Dusky Sounds, the French Pass, Queen Charlotte and Pelorus Sounds. Although not abundant in the North, the butter-fish is found at Kawau, where Sir G. Grey considers there are two varieties.

COD.

Under the popular name of cod at least four kinds of fish are recognised and thus classified: *Percis Colias, Lotella Bacchus, Lotella rhacinus* and *Pseudophysics brevisculus*, of which the following details are known:—

Rock Cod *(Percis Colias).*

Length about three and a-half times that of the head, which is from five to seven times the diameter of the eye, which is equal to the interorbital space; præoperculum entire; operculum with one or two small compressed spines; spinous portion of dorsal much lower than the soft; tail square.

Colours variable; back and sides, dark green, marbled with brown; top of the head, dark brown, with a patch of green over each eye; belly, greyish white; fins, pale greyish, more or less spotted with brown, especially the posterior part of the dorsal; immature specimens want the green colour, but have the back and sides brown, more or less marbled with greyish white, and with more spots on the sides and fins.

Abundant all around New Zealand; not found elsewhere.

This is the coal-fish of Captain Cook, and blue-cod of the settlers in the South, and the pakirikiri of the Maoris, and is the most commonly-caught fish among rocks on the coast. When quite fresh it is wanting in firmness, but if slightly salted for twenty-four hours it is greatly improved in quality. In the neighbourhood of rocks, in from 10 to 15 fathoms of water, is the best fishing-ground for the rock-cod, but they are also caught inside harbours, and even far up the Sounds on the West Coast, keeping at about 10 fathoms below the surface alongside of the great submarine precipices that descend vertically for more than 1,000ft. They are, however, rarely brought to market, although they may be caught at any period of the year. Their full size is about 5lb. weight.

Around portions of Stewart Island they are found in very large numbers, as well as in Cook Strait. Of the former place Mr. Pearson wrote, some 15 years or more since: "Though caught in the bays, it is found in largest numbers all along the North and East coast of the island from Rugged Point to Wilson Bay. The sea, looking through its clear pellucid water, appears literally to

swarm with them. Off Smoky Cove and other favourite localities, I have seen them pulled up with lines three or four to each as rapidly as the baits could be fixed and let down. I believe three or four good fishermen could fill a whaleboat in three or four hours at any of these spots without moving." He adds: "It cures splendidly." They are abundant around the Barrier and Kawau, but are not fished for. They can be caught, Captain Fairchild says, in any quantity about the French Pass, Pelorus and Queen Charlotte Sounds. They are easily cured, salted, or smoked, and could be exported in any quantities.

Red Cod *(Lotella Bacchus)*.

Length, four and a-quarter that of the head, or four and a-half times the height of the body; upper jaw rather longer; ventrals pointed; dorsal and anal when laid flat do not overlap the commencement of the caudal; distance of the end of the dorsal from the end of the tail equal to two and a-half times the depth of the body at the end of the dorsal.

Reddish or greyish silvery, with fine brown reticulated markings on the back and sides; below and ventrals, whitish; dorsal like the back; lower lip and barbel, red; a black spot in the upper part of the axil of the pectorals; iris, greyish white.

Red-cod (also called the yellow-tail and the haddock) is a well-known fish on some parts of the coast, being the species that is cured and sold as the Findon haddock. It is a handsome fish, with a brilliant play of metallic colours when alive. The usual size is about 24in. in length, and weight 4lb. to 5lb. They are generally obtained with the hook where there is a sandy bottom, in 10 to 15 fathoms of water. They are common in Port Underwood, and are netted in Wellington Harbour, and though rarely got on the exposed parts of a rocky coast, are caught in abundance from vessels lying at anchor in the roadsteads off Hokitika and Greymouth. They are very plentiful about the Bluff.

Only found in New Zealand. It was described by Mr. Thompson as the most plentiful of all the finny visitors (to Otago), and is caught both inside and outside the Otago Heads. It is in finest condition during the winter months, when pretty large takes of good-sized specimens are got from the outside fishery, those caught by the seine-net in the harbour, being, as a rule, smaller. It was found in the Dunedin market 197 days in the twelve months, on an average for three years. It is by no means a frequent visitor in the northern fish markets.

Hake *(Lotella rhacinus)*.

Length four times that of the head; upper jaw longer; ventrals pointed; dorsal and anal when laid flat overlap the commencement of the caudal; distance of the end of the dorsal from the end of the tail equal to one and a-half times the depth of the body at the end of the dorsal.

A closely-allied species to the *Lotella bacchus*, having a larger head and longer fins, has been termed the hake; but it is apparently a rare fish in these latitudes, and only small-sized specimens have been seen.

Mr. Travers, some years ago, brought specimens from the Chatham Islands.

Whiting *(Pseudophycis breviusculus)*.

Another fish of the cod kind, which has a deeper body than the *Lotella rhacinus*, and more delicate flesh, resembling that of the whiting. It is abundant on the west coast of Otago, where specimens are caught with the hook, in 15 fathoms water, at the entrance to Dusky Bay, weighing about 5lb.

Mr. Thompson says they are occasionally found in the Dunedin market; and Mr. Wilson, that they are unknown in the North.

There are beside the fish here called the red cod, the hake, and the whiting, five other members of the gadidae, or cod tribe, in the New Zealand waters, one of which, the haddock, is written of under its proper heading. When it is remembered that this family is the most valuable to mankind, in the production of food and money, of all the different tribes of the sea, we should be gratified to find that we have more of its representatives around us than there are mentioned in Mr. Macleay's descriptive catalogue of the fish of all Australia. What is called the rock cod (*Percias Colias*) belongs to another family than the gadidae, having for its cousins, among many, the flathead and the cat-fish.

CONGER EEL *(Conger vulgaris)*.

The dorsal fin begins a little behind the extremity of the pectorals; posterior nostril on a level with the upper margin of the eye; jaws nearly even in front; tail longer than the body in the proportion of three to two.

Sometimes dark grey above, and paler below; sometimes pale brown above, largely mottled with white; below, white; fins dark grey, immaculate.

Known to the Natives as the ngoio, and attains a very large size, with a length of 6ft. It is caught in abundance, especially in Cook Strait, and may be said to be plentiful in all our waters. It prefers deep water, up to about 50 fathoms, where there is a rock bottom or sandy patches, surrounded by rocks which are covered by weeds. It is more readily captured at night, especially if dark; and, though migratory, does not seem to have been taken in fresh waters. Soon as captured it should be knocked on the head, as it is not a pleasant companion in a boat. Congers are captured by hooks and lines, either used by the hand, or long lines with hooks at regular intervals. They require baits fresh or moderately so.

Though rarely seen in the London markets, with proper treatment it yields a most appetising and nutritious food, and is largely utilised as the basis of various soups, and, in the Channel Islands, is made into soup, locally known as *bouillabaisse*. Conger stewed after the Lancashire fashion, in milk with a little butter, pepper, salt, and just a flavour of onion, can be highly recommended, says Mr. Kent. People in Picton maintain there is no fish more excellent than the conger when baked. That it was a favourite in olden time may be gathered from an Athenian enthusiast, that "The odour of a cooking conger would make a dead man sniff." It is one of the best materials for making the stock of turtle soup; the turtle often furnishing only the garnish and the name.

The method in which they used to be cured was by splitting them, then hanging them on a frame until dry, leaving the fat to exude before use. A large trade in salted conger was formerly done with Spain by the English fishermen. A considerable quantity, Mr. Day says, is tinned and exported; while dried and grated, it is used to flavour soups. In many parts of Scotland the conger is rejected, but sells readily in Edinburgh. In some places they are furnished as a heriot. Attention is directed to it here as a fish available in quantities for export to Eastern markets.

Borlasse mentions one taken in Mount Bay of 100lb. weight; in 1879, one 128lb., and 8ft. 3in. in length, was seen in the London market; one of 112lb. was taken by Mr. Dunn at Mevagissey; and Yarrell writes of one of 130lb.

EHOUHOUNAMU (*Chilodactylus spectabilis*).

Described by Captain Hutton in this manner: Length three and one-third times that of the head, or three times the height of the body; six simple pectoral rays projecting beyond the membrane; fifth the longest, reaching to the perpendicular from the

fifteenth or sixteenth dorsal spine; the lower rays graduated; branched rays simply divided only; sixth and seventh dorsal spines nearly equal and longest; the third anal spine longer than the second; scales rugose; lips very thick and fleshy; opercles with small scales; nostrils large, close together, the anterior with an appendage behind.

Brownish orange, with traces of six transverse bands of darker; soft dorsal, anal, caudal, and tips of ventrals blackish; lips and throat grey; belly silvery. Length of the specimen from which the description was made, 24in.

Dr. Hector says it is common near the East Cape, and is called by the Natives ehouhounamu or nanua. The family to which this fish belongs—the *Cirrhitidæ*—contains the hiwi-hiwi, the tarakihi, the moki, the trumpeter, and the porae, most of which are well-known fish, and stand, as it were, sponsors of its belonging to a good parentage.

The same fish is found in Tasmania, where it is called the "carp," and thus written about by Mr. Johnston: "Although the carp of the fishermen is common in the market, it is not to be depended upon, for the few that are caught are only found at odd times in the graball while fishing at the mouths of estuaries for the bastard trumpeter (*Latris Forsteri*). There is a ready market for all that are taken, however, for, although somewhat coarse-looking fish, they appear to be highly esteemed. They are moreover strong fish, and will live a considerable time in the well. They are seldom taken by hook and line. Little is known of their habits."

FLAT FISH.

Under this term are sold many species of valuable food-fishes, which are justly the most highly esteemed of any in our markets. They are all, with one exception, of small size, and frequent estuaries, saltwater lagoons, and the larger rivers.

"Flat-fishes," Mr. Day writes, "are among the most remarkable of vertebrate animals, as, for about a week or more after their birth, they swim on edge in a manner similar to other fishes; but as they grow older this erect position becomes lost; their sides become the upper and lower surfaces, while both eyes are on the superior or coloured side of the body. The adult, when at rest or swimming, usually keeps near the bottom of the water, and progresses by means of a sort of undulating motion of the whole body, and of the unpaired fins. From a very early age it had been known that these fishes, when first emerging from the ova,

and while in a pellucid condition, have an eye on either side of the head; that by degrees the eye, on what eventually will be the eyeless side, becomes depressed, while at the same time a dark spot appears on the opposite side of the head, so that the fish almost seems to possess three eyes. By degrees this dark spot becomes a distinct eye, while that on the other side gradually disappears. In short, the eye apparently migrates from what is henceforth known as the blind side of the fish. With increasing age the eye on the blind side rises higher and higher towards the median longitudinal line of the head. The back fin gradually extends towards the nostrils, and finds its way behind the eye which has come from the blind side."

Some flat-fishes have the eyes normally on the right side of the body, others on the left, but reversed instances, or those in which the coloured side is on that which is, as a rule, uncoloured, are not uncommon among most genera. Such is very frequently observed in flounders, these fishes, living close in-shore, being more exposed to the action of currents than those genera which live in the deep sea. In this way they become, in their very early life, forced on to the side which is not the normal one. Such variations are more commonly perceived in some localities than in others, and will generally be found due to local disturbing causes.

Among these fishes it appears as if the female sex largely preponderated over that of the male. It also seems probable that their eggs float when deposited in the sea. In the earlier stages of their existence, during the spring months, flat fishes pass their lives close to the coast; they swim on the surface, and appear more active if the wind is setting in-shore, perhaps taking advantage of it to return towards home.

Many legends, doubtless, are in existence throughout the universe regarding how these fishes became coloured on one side only. Klunzinger tells us that in Upper Egypt a tradition is prevalent that Moses was once cooking a fish, but by the time it had been broiled until it was brown on one side, the fire or the oil gave out. Moses, in a temper the reverse of amiable, threw the fish into the sea, where, although half broiled, it came to life again, and its descendants have up to the present day preserved the same peculiar appearance, being white or colourless on one side, and coloured on the other. In Constantinople a ...r story is told of these fishes, but Moses retires in favour ...ltan, Mohammed II., the conqueror of Stamboul.

In some of the genera forming this family it is very interesting to observe the different plans on which the eyes are modified and protected. Thus the plaice or the flounder are able to move these organs horizontally, or even vertically, and it appears as if the two eyes, to a certain extent, act independently one of the other. In the turbot this organ can be covered, for not only does a thick skin invest the upper and lateral portions of the globe, as in most of the flat fishes, but being insufficient to protect the eye from the irritation of the sand wherewith it covers itself, it is able to elevate a thick lower eyelid, or else to depress the transparent portion of the globe of the eye beneath this folding.

All the flat-fish are said to be carnivorous. They live chiefly off cockles and other molluscs, off bugs and lobworms, or small shrimp-like creatures, and other crustaceans. To this, however, there must be an exception, as the fresh-water sole of New South Wales (*Synaptura selheimi*) is said, by the Rev. Mr. Woods, to be caught "by a bait of grass."

PATIKI (*Rhombosolea monopus*).

Length three and two-thirds that of the head, or one and four-fifths the height of the body. Olivaceous brown, with reddish tints on the head and fins; below greyish white.

The patiki is very common in the shallow bays and tidal estuaries on every part of the coast, and is everywhere highly esteemed both by Natives and Europeans. They are generally obtained with the net, but on the shallow mud-flats the Natives capture them with a long slender spear, choosing the night time, and each carrying a lighted torch, or a pan of flaming kauri gum, on the shoulder, which attracts the fish, and enables them to be observed and impaled as they glide over the bottom. The usual weight of this delicate fish is from ½lb. to 2lbs., but they are frequently obtained of a much larger size. They are very abundant at the Thames, and declared by good authority to be equally so in the Kaipara waters. Lake Ellesmere, in Canterbury, is also a famous place for patiki.

They are described as a fish which can be caught all the year round, and in Tasmania as having decreased in size and numbers from over-fishing; but one witness before the Commission, Mr. Richard Irvine, of Launceston, wrote that: "Latterly, however, the fish had reappeared, and the fishermen report them as numerous as formerly." The regulation size for their sale in Tasmania is 10 inches, but a large number are sold of a smaller size; but it was stated that: "In the summer time nine out of

every dozen thrown back into the water died." The small fish, in fact, had been killed in the capture of the larger. Evidence was given that they were unfit for food from November to February. In July, it was said, they were in full roe, the fisherman adding: "I have caught them full-roed this month, and next with none in them. They go into deep water after spawning."

They spawn, without doubt, as do all other flat-fishes, on banks and shallow waters—most frequently near the mouths of rivers. They do this, as they leave the hatching to the sun. Their duties as parents are at an end when they place their spawn in a sunny shallow. This accounts for the sort of annual migration which takes place among the flat-fish generally. In Tasmania, a close season for flounders is advocated in agreement with the old law of the Cinque Ports, prohibiting the capture of certain flat-fish between 1st November and the 15th of March. Here, of course, the close season would be in accord with the climate.

Sole *(Peltorhamphus Novæ Zealandiæ)*.

Length three and one-fourth times that of the head, or two and four-fifths the height of the body; lower eye slightly in advance; anterior rays of the dorsal protrude beyond the membrane.

Olivaceous grey, dotted with black, and with two dark spots on the lateral line; caudal reddish.

The New Zealand sole is an inferior table fish to the patiki, and not equal to the English sole in flavour. It is not so common as the patiki, and for that reason alone is more in request, and commands a better price in the market. The sole is caught along with other flat fishes, and is easily distinguished by its oval shape and curious hooked fleshy snout, which conceals the mouth on its upper side.

They are occasionally found in the Wellington market, of considerable size; and frequently in the Kaipara waters. Of Dunedin, Mr. Thompson writes: "Soles are somewhat rare in our market, and are most plentiful in spring. Two varieties appear to be caught here, differing but slightly from each other; were thirty days in the market last year, and twenty this year. If trawling were introduced in suitable localities along the coast, the fish would be more plentiful." They are by no means uncommon at Napier, and in some years—1870, for instance—were caught there in considerable numbers.

If we take a young sole as a study, and note some of the incidents of its career, we shall be rewarded for our pains. When we see it first it is lying flat on its left side, on the sand at the bottom of the water in which it is growing. This is after it has given up the vagabond life of its earliest days, when it was a wanderer on the face of the sea. It has now settled down for life, and finds that there is nothing for the left eye to see or to do in the lopsided existence it has been called upon to assume. The result is, as has been well said by a writer in the *Cornhill*, to whom the compiler is indebted: "The left eye takes to squinting round the corner, and continues to do so until half the face of the young sole, except the mouth, is twisted round to the opposite cheek." The habits of the sole, it may be said, are the habits of the group to which it belongs. Was it the custom of the ancestors of the flat-fish, of lying always on one side, that made their descendants flat? Such is by no means an uncommon explanation applied to questions of this character.

Mr. Robinson has, however, a Polynesian theory for the flatness of the sole, which he thus relates: "Ina, the daughter of Vaitooringa and Ngaetna, attempted to flee to the Sacred Isle. She had asked one fish after another to bear her thither, but they were all unable to sustain such a burden, and upset her in shallow water. She at last tried the sole, and was successfully borne to the edge of the breakers. Here again she was unshipped, and the heavenly maid was so provoked that she stamped on the head of the unfortunate fish, and with such energy that the underneath eye was squeezed to the upper side. 'Hence the sole is now obliged to swim flat, with one side of its face having no eye.'"

The sole and his cousins are not of a fighting order, and are moreover very good to eat. They have few means of protection, and the dog-fish are as anxious for their acquisition as are men and women. So it has become their habit to lie lurking on the sand, with which they sometimes cover themselves, or settle in a comfortable hollow. As they feed the sand is disturbed, and the fish can be seen by those anxious to spear them.

As the young sole lies permanently on its left side, it loses the power of swimming vertically, and wriggles along the bottom with "a slow, sinuous, and undulating motion." It has no business at the surface of the sea, and so it has no air bladder. If it had it would be a great inconvenience to its habit of lurking at the bottom of the sea, seeking to make the inquisitive dog-fish think it to be merely a sand-bank and nothing more. The sole has evidently come from unaspiring and unambitious ancestors.

Soon as the young fish—which started in life as transparent as the motives of a child, though the pigment cells are as well developed on one side as the other—begins to lie on one side, the upper portion of its body begins to grow dark, and assumes the particular tinge on which it reposes. So perfect is this assimilation, that the writer we are condensing says: "The edible sole lies always on sandy banks, and the spots upon its surface are so precisely similar to the sand around it that in an aquarium, even when you actually know from the label that there is a sole to be found in a particular tank, you can hardly ever manage to spot him as long as he lies perfectly quiet on the uniform bottom." It is on this power of deceiving its vigilant foes that the flat-fish relies for preservation, as the dog-fish soon find out "that all is not sand that looks sandy." An Albino sole has a short career. According to Mr. Holdsworth, some of the European soles spawn in the open sea.

As the habits of soles are much alike all the world over, the following details from the *Fish and Fisheries of New South Wales*, are suggestive. Mr. E. Hill says: "The flounder takes a bait as he is swimming, and is armed with rather formidable teeth, set in a mouth across. The sole will not take a bait, nor does he feed except when only perfectly flat on the ground, dark side up, and generally with sand and *debris* to the eyes, leaving his mouth free to take in food."

For amateur fishermen, as well as others, the following hint may be of service. The same writer says: "The usual or only method of taking the sole is by spear during the calm mornings in winter, when the water is clear—the slightest ripple is a serious obstacle. This is sometimes overcome by a little grease or oil on the water, and it is usual to take a piece of fat meat for that purpose. The spear should have but one fine steel prong, with which you probe the sand on their feeding patches; and when the fish is pierced it makes no resistance, and is easily brought to the surface. Very frequently two are pierced and brought up at the same time; and in one or two instances I have seen three brought in with one probe, by striking the spot where they had accidentally overlain each other in the feeding patch."

The trawl is the usual mode of capture. The sole is mostly a night feeder. It spawns during the spring months. A sole of 1lb. weight carries about 134,000 eggs. The skin, according to Parnell, was used for fining coffee, being a good substitute for isinglass; also as a material for artificial baits. During the breeding time their flesh is soft and watery. The largest recorded size of the English sole is 26in. in length, weighing 9lb. Mr. Epton considers the sole is of slow growth, and conjectures the size of

2in. to 4in. in length for one year's growth; 5in. to 9in. at two years; at four years some contain spawn; and at five years they are large soles, and that they continue to grow slowly a few more years. The sole is an intensely local fish—not caught in quantities, only in certain places. Few, for instance, are found in the North Sea. Their places of resort here will have to be as carefully marked in our waters as those of the maomao or trumpeter. They do not "school" as do the plaice and haddock. The French call them "Perdrix de mer," the "Partridge of the sea."

The sole frequents estuaries because it finds a large portion of its food there. A large proportion thereof is supplied by the mud which they swallow containing organisms in a living or decomposed, or semi-decomposed state, with which such localities abound. The flesh of the fish is not so firm when it lives in a sandy home as when it has a feeding ground where organic matter is mixed with mud. "The intestines of the sole," the Rev. Mr. Houghton says, "are often quite black from the mud they swallow; and if the stomach and intestines be opened and the contents examined in a shallow vessel of water, the particles of sand and dirt at once reveal themselves."

Of the abundance of the New Zealand sole, or its scarcity, we cannot even speak with any certainty until more is known of its habits, if it resembles the sole of the North Sea, which, we are told, generally resort for a long snooze in November to a deep depression known as the Silver Pits, lying close beside the Dogger Bank. "These Silver Pits," a late writer says, "are so called because, when they were first discovered about the year 1843, they formed a sort of big bonanza for the lucky fishermen who originally resorted to them. There the soles lay huddled together for the sake of warmth, like herrings in a barrel, thousands and thousands of them, one on top of the other, a solid mass of living and sleeping sole-hood, only waiting for the adventurous fisherman to pull them up and take them to market. He dropped his line into the Silver Pits—the water there is too deep for dredging—and hauled up the helpless drowsy creatures literally by the thousand, till he had half exhausted the accumulated progeny of ages." A similar discovery was made in 1848, "on a small tract of coarse bottom near Flamborough Head, where the soles retired to hibernate." These details are given to show how exhaustive research must be before the abundance or scarcity of any particular fish inhabiting our waters can be determined.

Brill (*Pseudorhombus scaphus*).

Length equal to four and three-fourths the length of the head, or two and three-fourths the height of the body; lower jaw prominent; teeth rather large, conical, pointed, the lateral ones of

the upper jaw the shortest; interorbital ridge very narrow, naked; left or lower eye rather in advance of the upper; dorsal commences before the eye; scales ctenoid, those on the cheeks smaller; curve of the lateral line flat above; the greatest depth between the anal fin and the lateral line is rather less than the length of the head.

Colouration uniform—brownish above, white below.

Of this fish, Dr. Hector writes: " It has been termed brill on account of its being the only one of our flat fish with the eyes on the left side of the head; but it is small in size, and so full of bones, that it cannot be eaten with any comfort." It was found by the Doctor in Preservation Inlet.

TURBOT *(Ammotretis Guntheri)*.

Length equal to five times that of the head, or not quite twice the height of the body; snout produced into a flap overhanging the lower jaw, about twice as long as the eye, which is one-sixth of the length of the head; lower lip with a fringe of soft rays; mouth small; interorbital space scaly, about one-half the vertical diameter of the eye; lower eye in advance; right ventral commencing on the chin; anterior rays of dorsal and right ventral almost free; longest rays of dorsal go about two and a-half times into the length of the head; caudal rounded, about as long as the head. Right side olivaceous with black spots, the spots more or less arranged in longitudal rows; fins and flap on snout tinged with red; left side yellowish-white. This is a description of the fish caught in Wellington Harbour in 1872, which was some 16 inches in length, " with plenty of fish on it."

Writing last year, Dr. Hector says this is the only deep-sea species of flat-fish known to us, and though unlike the turbot, is a most delicious fish. It will rarely be seen in the markets until deep-sea fisheries are established. Mr. Masefield says they are occasionally found at Kaipara. They are sometimes seen in the Auckland market.

As our turbot belongs to the same family as the turbot proper, of which there are varieties, both in form and colour, and considering how high an estimation the turbot has acquired, we can only hope that the New Zealand variety may become as famous as that of the other hemisphere. As cousins among fish, as well as cousins among men and women, manifest similarity of habits, a few details concerning the turbot proper may not be out of place.

There are double turbots as well as single ones, and one taken at Montrose weighed 11lb., where, Mr. Johnson says: "We see sometimes in the course of the year two or three of them, and then for years won't see any." Couch gives an instance of a turbot being coloured on both sides. It is fond of sandy bays and muddy bottoms, frequently changing its residence and migrating into deep water, after the manner of soles, in cold weather. It is called and known as a deep-sea fish. It is extremely tenacious of life after capture. Houghton says it swims often in companies, but cannot properly be called a school-fish, like the plaice; is a great wanderer, and in warm, calm weather it often comes near the surface, and seems to enjoy the sun. It was formerly preserved by the Romans in salt-water ponds, so as to be readily available for market. Mr. Day writes: "The turbot apparently augment more rapidly in an aquarium, when supplied with suitable nourishment, than they do in the open sea. Thus, in the Southport aquarium, some, about 3in. across, increased in two and a-half years to 10lb. in weight; and after two years more they further augmented to 20lb., or a yearly average, in amount, of 4½lb. a fish." In ancient times the largest fish were considered the best, and its culture was considered of so much importance that the Emperor Domitian, we are told, convened the Senate to determine in what manner a mighty turbot should be cooked. By Act I., c. 28, of George I., a turbot under 16in. long; brill, under 14; codling, 12; whiting, 6; bass and mullet, 12; sole, 8; plaice or dab, 6; and flounder, 7in. long, were forbidden to be sold.

It is generally taken by trammel and beam trawl nets; but when the fish retire to deep water, or rough ground, long lines or boulters are employed; and off the Dutch Coast, in warm weather, Day says "they are often taken in shallow water." In County Down, fishermen employ a spear 32ft. or 33ft. long, armed at its extremity with an iron barb; the fishermen even drive it down upon them when beyond their reach." Spears of the same kind are also used by the fishermen at Newcastle. Turbot weighing 20lb. and 30lb. are so taken. Thompson writes: "As baits, fresh herrings, sand smelts, pilchards, slices of other kinds of fish, and lamperns, are used for turbot; the latter are preferred by the Dutch, who excel in turbot fishing. The bait should be very fresh, as the turbot is somewhat fastidious, and will refuse any bait if it be tainted. Bright, silvery bait, sufficiently tough to stand the usual effect of line secured to the hook, is the best. As a rule, untainted bait is always preferred by fishermen. They are sometimes caught in quantities when found in companies. Thus, Buckland tells us that in June, 1870, a large number—1500—had been taken on the fishing ground, about 40 miles from Heligoland, by one vessel.

The turbot is one of the most prolific fish known. In a specimen which weighed 23lb., Buckland found the roe to weigh 5lb. 9oz., and computed the ova to be upwards of fourteen millions. It is said to spawn near the surface of the water. It attains a great size. Thompson, in his *Natural History of Ireland*, mentions one caught off County Down, 44¾lb.; Couch records one, near Plymouth, 150 years ago, which weighed 70lb.; and one is said to have been caught at Whitby, in 1832, of 190lb., and measuring 6ft. across. "This," says Buckland, "I do not believe." The weight of Domitian's fish is not recorded.

In the *Transactions of the New Zealand Institute*, vol. viii., p. 215, Captain Hutton writes thus of the *Ammotretis rostratus*: "A fish not uncommon in the Dunedin market, where it goes by the name of "lemon sole," agrees so well with Dr. Günther's description of *A. rostratus*, from Tasmania, that I have no hesitation in considering it that species. The chief difference is that in the New Zealand fish the height is rather more than half the length. In Macleay's catalogue it is mentioned as "having the upper part of the snout produced into a flap overhanging the lower jaw. Colour uniform—brownish olive." Mr. Johnston says it is called "the sole" of the fishermen of Tasmania, and found in considerable abundance all the year round. In the classified catalogue of Tasmanian fishes it is mentioned as "taken in graball; does not take bait."

As the "boulter" has been referred to above, this may be an appropriate place for the insertion of its description, premising that it is much used for the capture of cod and other fishes on the Newfoundland banks, and in the North Sea fisheries of Norway. It is variously called "boulter," "bulter," or "bultow." In *Simmond's Commercial Products of the Sea*, the bultow, as used by the French fishermen at Newfoundland, is described as a "long line with hooks fastened along its whole length, at regular distances, by shorter and smaller cords, called 'snoods,' which are 6ft. long, and are placed on the long line 12ft. apart, to prevent the hooks becoming entangled. Near the hooks these shorter lines or 'snoods' are formed of separate threads, loosely fastened together, to guard against the teeth of the fish. Buoys, buoy-ropes, and anchors or grapnells, are fixed to each end of the line, and the lines are always laid, or, as it is termed, 'shot,' across the tide; for if the tide runs upon the end of the line the hooks will become entangled, and the fishing will be wholly lost. For the deep-sea fisheries the 'bultow' is of great length. The French fishing vessels, after anchoring on the bank in about 45 fathoms of water, run out about 100 fathoms of cable, and prepare to catch cod with two lines,

each 3,000 fathoms in length. The snoods are arranged as previously described, and the hooks being baited the lines are neatly coiled in half-bushel baskets, clear for running out. The baskets are placed in two strong-built lug-sail boats, and at three o'clock in the afternoon both make sail together, at right angles from the vessel, on opposite sides. When the lines are run out straight they are sunk to within 2ft. of the bottom. At daybreak next morning the boats proceed to trip the sinkers at the extremities of the lines, and while the crew of each boat are hauling in line, and unhooking fish, the men on board heave in the other end of the lines with a winch. In this way 400 of the larger bank cod are commonly taken in a night. The fish are cleaned and salted on board, and stowed in the hold in bulk; the livers, to be boiled for oil, are put in large casks, secured on deck."

Mr. Wilson suggests that flat-fish, of various kinds, should be cured and put up in tins from 1lb. to 3lbs. in a tin like kippered herrings. He has tried them, and find they both can and sell well.

There are at least four other kinds of flat-fish in our waters —*Rhombosolea leporina*, *Rhombosolea tapirina*, *Brachypleura Novæ Zealandiæ*, and the *Pseudorhombus boops*, the latter of which was dredged by H.M.S. Challenger, in 400 fathoms, off Cape Farewell; but little, or comparatively nothing, is known of their habits or habitats.

In the paper on the Tasmanian fishes, written by Mr. Johnston, and published with the report of the Royal Commission on the Fisheries of Tasmania, when dealing with the decreased size of the flat-fishes brought to market in later years, he says: "It would seem to be impossible to regulate the mesh of the seine so as to allow the escape of the young fry or flounders and other important food fishes, and large numbers are destroyed either through wanton carelessness in not immediately returning under-sized fish to the water, or because they are actually destroyed by the drawing of the seine net. As the use of the seine needlessly destroys young fish far out of proportion, its use should be confined to particular localities."

But little is known as to the habits of our New Zealand flat-fish, and the Australian evidence on the subject is meagre in the extreme.

FROST FISH (*Lepidopus caudatus*).

Length ten times that of the head, or fourteen and a-half times the height of the body; length of the head three and three-quarters the diameter of the eye; snout more than half the length

of the head; lower jaw longer; the upper jaws with a row of about twenty-three lancet-shaped teeth on each side, those in front much smaller; near the front two pairs of long fangs, the hinder ones longer, and the left rather in advance; lower jaws with a pair of small fangs in front, and a series of about eighteen smaller teeth on each side, the hinder ones the largest; operculum angular above, rounded below, the posterior margin fringed; the maxillary does not extend quite to the vertical from the anterior margin of the eye; caudal deeply forked; a short thick barbel at the symphysis of the lower jaw.

Bluish silvery, rather darker above.

The frost-fish, or hiku of the Maoris, is esteemed the most delicious fish in New Zealand. It is most commonly found cast up after cold frosty nights on sandy beaches that are exposed to the long roll of ocean swell, and is not in this country obtained by any kind of fishing. A very similar fish occurs, however, on the south coast of England, and, according to Yarrel, is occasionally found entangled in nets. The usual length of this fish is about 4ft., but from its compressed form it weighs only about 4lbs. The frost-fish is more frequently brought to market in Dunedin than elsewhere in this Colony, and sometimes fetches 2s. 6d. per lb., but during the winter months a considerable number are picked up on the beach between the Otaki and Manawatu, and brought to Wellington by the coach-drivers. On a still, frosty morning in Breaksea Sound, on the west coast of Otago, I once saw what we thought to be a frost-fish skimming the sea in a tortuous course with its back fin rippling the water, and evidently feeding on some prey that it obtained near the surface; but nothing is definitely known of the habits of this singular fish, or why it should be cast up on the land, the probability being that on the calm nights when the sea is smooth it pursues its prey too close to the shore, and is left by the long swell during ebb tide. Thus writes Dr. Hector.

This opinion of Dr. Hector's, of the frost-fish pursuing its way to land in search of prey, is controverted by Mr. C. H. Robson, who gives some interesting details of its habits. He writes: "It is true that the frost-fish usually comes on shore during the cold moonlight nights of winter, but it also frequently lands in Clifford Bay, near Cape Campbell, during the daylight, always when it is calm, or with a southerly wind and smooth water. It has been my good fortune to witness several such landings, and, though unable to determine the reason of them, I can state positively that the fish is not cast up by the sea, but that it deliberately forces itself on shore, selecting a shallow sandy beach for that purpose. My first thought was that it came to rid itself of some external

parasite by scouring on the sand; but a careful examination of some fish thrown out of the water by hand before they could touch the sand showed me this was not the case.

"Having discarded the idea that the fish came to rub off parasites, I next thought that it might be blind, and not know where it was going, but I soon found out that it could see as well as myself. On two occasions I stood between a frost-fish and the beach, and, as he came on, turned him with a long stick head to sea, making him swim out, but, in a minute or two, he turned again for the shore, going up high and dry as fast as possible. So, as he seemed to have set his mind upon landing, I gave up the attempt to influence his decision, and took him home for breakfast. All the frost-fish which come on shore here are in fine condition; they seem to be in perfect health, and their landings appear to be deliberate acts of self-immolation. Their food I believe to be the young of the *Clupea saga* (the pilchard), or *Clupea sprattus* (the sprat), but I have only found one specimen with food in its gullet sufficiently perfect for identification."

Mr. Thompson, writing in 1877 from Dunedin, says: "Frost-fish have been scarce until the middle of July, when, during some clear *frosty* weather, with a young moon, they were for a few days quite plentiful, some of the shops having from three or four up to twenty. Nearly seventy were caught in one day at or near Purakanui. They were brought to market on eleven days. Settlers along the seaboard to the north have found them pretty frequently."

"And again the year following," he writes, "a few frost-fish were caught—I should rather say picked up, for the fish is never caught, in the ordinary sense of the word—in August, and again in April, but towards the end of June and nearly all July large numbers of this fish were caught in town, one dealer passing no fewer than 109 through his hands in a fortnight, mostly brought from the vicinity of Purakanui. On all the beaches to the west of the Heads and away to the north, particularly about Moeraki, large numbers were got. Nothing is yet definitely known as to why this fish comes ashore in the peculiar way it does. But I may here give you the latest theory, as it appeared in one of the papers here a week or two ago. The writer said: 'The stranding of these fish is accounted for from the fact that, not being well supplied with fins, they swim with an undulating motion, like that of the leech, the head being elevated. In cold weather they follow their prey into shallow water, and, when the tail touches the ground, they become helpless, and are washed ashore.' The writer was very easily crammed. It is a noticeable fact that all the fish are about the same size—4½ft. to 5ft. in length. They were in the market twenty-eight days, being the longest yet known."

Dr. Lendenfeld advanced a new theory in 1883, a digest of which appears in the *Journal of Science* for May, 1884, in this manner: "This fish is ribbon-like and trapeziform, deepest close behind the head, and gradually tapering away, and of silvery colour throughout. The large eyes stamp it as a deep-sea form. The specimens thrown on the beach attain a length of 120 to 150 c.m. (roughly, 3ft. 4in. to 4ft. 4in.); they are never found smaller. With the intention of finding out the reason why these fish are thrown on the shores in great numbers, and only at a particular season of the year, I examined several specimens. I found males and females, in part with fully developed sexual elements, and in part without mature ova or spermatozoa. In all likelihood, in these latter cases, the sexual elements had been parted only a few hours previously. It would seem to follow from this that the time at which the deposition of the roe and milt takes place corresponds with the time of year at which the fish are cast up on the shores. A second and more important conclusion arrived at in this investigation was, however, that in every case the swimming bladder was burst, and a great internal hemorrhage was apparent. I have no doubt that at the time of deposition of the ova, the males and females seek protection places at the bottom of the sea, and that at this particular period fishes which live on the coast may often swim up the (ascending) sea-bed, and arrive in depths of water where such a low pressure prevails that the muscular apparatus of the swimming bladder is no longer able to compress the air in it so strongly, and the specific gravity of the whole fish becomes equal to that of the sea water. Weakened by the act of deposition of the sexual materials, the fish is no longer able to get back by swimming to a suitable depth. The higher it ascends the more difficult it becomes to return to the deep water, and soon this becomes quite impossible. Always ascending higher, the fish, powerless and paralysed by the pain of the distension of the swimming bladder, reaches a region where the bladder bursts. The fish dies from the internal hemorrhage. A portion of the air remains behind in the body and keeps it afloat, where it remains, if not snatched away by an albatross or shark, until it is thrown up on the beach."

In answer to the German doctor, Mr. Arthur replies in the July number of the same serial, alleging, first, as to the theory: "The discomfort to which the fish would be subjected at the first portion of its ascent from assumed great depths towards shallow water, would instinctively cause it to return to those depths long before it had lost all control over its air-bladder; or, supposing the bladder to be distended to the bursting point, then the fish would float belly uppermost before it got stranded, which is not its manner of coming ashore."

From inquiries the writer instituted among the fishermen who live at Purakanui, he elicited the following details: "These fish not only come on shore during frosts, but they are cast ashore during heavy tides, when there is no frost; also on the termination of frost, when the thaw commences. They have also come, or been washed on to the rocks, during the summer, at Purakanui, as in December. When seen to come first on the beach they try to bite their tails. A frost-fish was netted on the Groper Reef in February, 1882, and several others have been so netted during the summer seasons, but the precise dates were not noted. The fish from the Groper Reef was found in the net when it was drawn ashore, but the net had been cast in 3 or 4 fathoms of water. No information was in possession of these fishermen as to the time or locality of spawning, and they had never seen roe in any fish; neither could they tell the ordinary depth of water frequented by frost-fish. But as to the young, they had seen several, ranging from 3in. to 15in. in length; while the adult fish feeds greatly on sprats, which it follows close in shore, even among the surf."

"There seem, however, to the writer, to be reasons enough for believing that this fish is always on the coast, or following in the wake of the shoals of sprats which come south in the end of summer, and return by the beginning of winter. Neither does its large eye necessarily determine it as a deep-sea form, as very small eyes, or even none at all, are quite as distinctive features of such forms."

Dr. Lendenfeld replies to Mr. Arthur on the eyes of deep sea fishes in the proceedings of the Linnean Society of New South Wales, 1884.

The frost-fish is frequently found on the beaches in the Bay of Plenty; occasionally stranded on the sandy beaches between the Waikato and the Manukau, and between the latter place and the Kaipara.

GAR FISH *(Hemiramphus intermedius)*.

Length three times that of the head, or five and three-fifths the projection of the lower jaw beyond the upper; upper jaw rather longer than broad; base of the ventral fin situated half-way between the base of the caudal and that of the pectoral; pectoral short; caudal emarginate.

Back, dark greenish blue; sides with a silvery band; pectorals blackish.

This name is applied both to the skipper *(Scombresox Forsteri)* and to the ihi or half-beak, which are allied fishes representing those of the same names in the British seas. The representatives of the former genus, however, though common in England, appear to be rare in these seas, while the half-beak, which is of rare occurrence in the British seas, is common all round New Zealand, and is the ordinary gar-fish that is so highly appreciated, especially in Auckland and Dunedin. Their length is about 12in. Angling for gar-fish in Auckland Harbour, where it is known as the piper, was thus graphically described by the writer of a letter which appeared in a number of the *Field*: "I have caught him in quantities in the harbour of Suez, at Aden, in New Zealand, and I have speared him by torchlight inside the coral reefs in the Society Islands, and everywhere I have found him a most excellent and delicate fish; indeed, once at Suez I remember the ayahs almost fighting for them as I drew them in, recognizing their excellence, and evidently used to them in India. In many parts of New Zealand they swarm in the estuaries at certain seasons of the year, and may be caught three and four at a time with a light, stiffish rod and fine tackle. I look on the piper as *the* float fish of New Zealand, for, though you may have plenty of fun with others here and there, he is the only one who really requires a float to keep his bait in proper position. His bait, to begin with, is a tiny bit of beef or mutton, wherewith you catch, most probably, a so-called 'herring,' which is not a herring at all, but which serves your purpose. Scaling him and cutting a wee triangular bit out of his side, and hooking it so as to make it play nicely, you fish till you catch a piper, and then you cut little triangular bits out of *his* side to entrap his brethren. The pipers are 'jest awfu' cannibals,' and you will be often informed on the Auckland Wharf that 'pipers is deeth on piper.'"

The piper, it may be added, is not so abundant in Auckland as when the above description was written, when in winter they were found there in shoals.

In Dunedin they are most plentiful during the months of October and November, according to Mr. Thompson's records; and in some years are remarkably abundant, large shoals being in the lower harbour for several days together, when they are caught in nets. So highly are they thought of in New South Wales that, Mr. Ramsay says, "No breakfast table should be furnished without them. When cooked the flesh is as white as snow, and of the most delicious flavour." During the latter end of February, 1880, the shoals in Sydney Harbour were so large that several boat loads were taken in one haul of the seine, and the fish on the spot could be purchased for sixpence a bushel. They are found chiefly, Captain Fairchild writes, about Cook Strait.

In Tasmania the following weighty utterance has been made: "Abundant during the summer months, and caught largely in seine-nets in our estuaries. They are valuable market-fish, although it is to be regretted that their mode of capture by the seine-net appears to commit great havoc among the young of other valuable food fishes." It may be added that the mesh of the seine-net used for the capture of the gar-fish in Tasmania usually measures only a quarter of an inch from knot to knot. They are caught at any time between April and October.

GRANITE TROUT *(Haplodactylus meandratus)*.

Length equal to four and one-third that of head, and to three times the height; body nearly round, thick in front; stout truncate, tumid interorbital space, convex; gape straight, almost interior, its length being less than the interorbital distance; mouth has tumid reflexible lips; both jaws armed with several closely-set rows of small tricuspid lancet teeth; patch of setaceous teeth on palate and on pharynx; tongue very short and smooth; four nostrils, anterior pair with tubular processes; præoperculum entire; operculum with a shallow notch; no pores above the head.

Both dorsals set on a fleshy base; the first two spines of the dorsal are short, being less than the diameter of the eye; fifth spine is longest, and two and a-half times in the height; fifth ray of soft dorsal the longest, and equal to spinous; length of soft dorsal is nine-thirteenths of an inch.

Anal with fourth ray longest, the base being short by one-third of first dorsal, with one spinous and one simple ray; caudal straight, the rays being equal to half the base of the first dorsal; pectoral with six or seven simple and partly free rays, the middle ray being the longest; ventral with one thick simple ray and five divided rays, the third being longest.

Scales small, oblong cycloid.

Colour uniform, but darker above and about the head; rich olive-brown in vermiform marblings, on a yellowish-gray ground.

Stomach elongated cylindrical, with thick rugose walls, and half the length of the abdominal cavity, liver forms a collar-shaped mass round the superior end; three short pyloric caeca; intestines membraneous, and five times the length of the abdominal cavity; urinary organ very large and exceeding the liver in bulk. Stomach and intestines full of corallines and sea-weed.

Largest specimen, 22in. total length.

The foregoing description by Dr. Hector is from several caught in a trammel-net by His Excellency the Right Hon. Sir James Fergusson, Bart., Pickersgill Harbour, Dusky Bay.

It is called by the Natives kehei.

Dr. Hector, in the *Transactions of the New Zealand Institute* (vol. 7.), says "That he has found it on all parts of the coast, and specially abounding round the headlands from the Kidnappers to East Cape. It is caught in large numbers by the Natives in the deep runlets excavated by the sea in the chalk marl strata, which form the coast-line, and for this purpose they use a peculiar net called the koko. This is a large scoop made with a bag-net suspended between two poles. With the rising tide this net is placed so as to block up one of the narrow runlets, and the fish are chased into the net from their hiding places among the kelp. Its flesh is coarse, with a rank flavour." Mr. Thompson differs with Dr. Hector, and says: "Though not a trout at all it is yet a very good fish, but only occasionally brought to (the Dunedin) market." In another place he describes it as being sent up from Port Molyneux, having been caught near the Nuggets. The largest specimen described by Dr. Hector was 22in.

GROPER (*see* HAPUKU).

GURNARD (*Trigla kumu*).

Length equals four times that of the head; interorbital space concave, less than diameter of the eye; snout elongate, with its upper profile straight; præorbital produced beyond the snout, denticulated anteriorly; operculum with two short flat spines, and a short, flat humeral spine; scales very small, those of the lateral line not armed; along the base of the dorsal on each side a row of spined scales; pectorals reach to the vertical from the tenth dorsal ray, ventrals much shorter.

Above, olive, largely mottled with reddish; below, reddish white; vertical fins, ventrals, and pectoral filaments pale reddish; caudal bright red; outside of pectorals blackish green, with rays reddish, inside olive green, with the upper edge and tip light blue, and with the upper ray and lower edge near the root reddish; an irregularly shaped, but sharply defined, black blotch near the lower margin, and several light blue spots on its margin.

The red gurnard, or kumukumu, is very abundant during the summer months in the harbours of the North, and full nets are sometimes drawn in Wellington with no other fish in them. The full-grown fish weighs about 4lb., but all sizes are used as food, the smaller ones being preferred. The flesh is firm and white, but rather dry. The grunting noise which this beautifully-coloured fish makes when caught is a great source of amusement to amateur fishermen. It is rarely seen in the Dunedin market. Though found all around the North Island, they are not as plentiful in many places as at Wellington. They can be caught with hook and line if fished for, and are found in some 15 fathoms of water. They may be called a deep-water fish. In early times, according to Maori legend, fish were all of one shape and colour, until a man, after many provocations, left his wife and child to provide for themselves. The wife went to Tangaroa, the god of fish, and desired him to punish her husband. Tangaroa collected his forces and made an attack on the settlement where the runaway husband was residing, and, by the aid of the fish, gained a great victory. To reward them for their heroism, he granted them any request they might make; and the gurnard, taking advantage of the offer, wished to be red, and to be able to groan like a dying man; hence his colour, and the "grunting noise" to which Dr. Hector draws attention. In flavour it is similar to schnapper when fresh in tins, and "will put up well in small casks."

The best way to cook the red gurnard is to stuff with force-meat, and bake in a quick oven, in a pie-dish, covered with a few slices of fat bacon. "If I be not a soused gurnet, I'm ashamed of my man," quoth Sir John Falstaff, which shows, a clerical writer says, that one way of cooking these fish in Elizabethan times was to fry, and then souse them in vinegar or some acid sauce, a mode recommended at a far earlier period in Athens: "Score the fish across the back, fry in oil, with a seasoning of salt, chopped rue, grated cheese, and serve soused in vinegar." A similar mode of cooking gurnard still obtains in France and Italy. Mr. Thompson gives the gurnard an indifferent character. He terms it "A pretty fish with long fins like wings, but is seldom eaten, though of good quality, but very bony."

HADDOCK (*Gadus Australis*).

Length equal to four and one-third times that of the head, or seven and a half times the height of the body; length of the head two and four-fifths that of the snout; diameter of the eye not much more than half the length of the snout; lower jaw longer; no barbel; strong teeth in both jaws, the outer series being shorter and fixed, the inner longer and capable of being folded back;

strong teeth in a double series on the vomer, none on the palatine bones; upper profile of head straight, snout conical; head higher than broad; maxillary extending to beyond the middle of the eye; scales very small; vent rather nearer to the snout than to the end of the tail, below the commencement of the second dorsal; a space between the first and second dorsal, the second and third sub-continuous; a short space between the anals.

Above, purplish; sides and belly, silvery; inside of the mouth white.

Thrown up on the coast by heavy storms.

It is said sometimes to attain a length of 4ft.

Captain Hutton subsequently wrote: "In a letter to Dr. Hector, Dr. Günther says that this fish should be referred to the genus *Merluccias*, and that it is probably identical with *M. Gayi* from Chile; an opinion with which I quite agree."

Dr. Hector writes: "The fish to which the familiar name of haddock has been applied (*Gadus Australis*) is a new species described by Captain Hutton (as above) from a few specimens that were cast up on the shore of Cook Strait after a heavy south-east gale. It would be a most valuable addition to our market if its ordinary habits were ascertained. He also found a specimen in Bruce Bay, in Westland." In 1878, Mr. Thompson wrote in his paper of that year on "The Dunedin Fish Supply:" "The haddock is caught occasionally, but there are seldom more than two or three got at a time."

Captain Fairchild says they are only caught in the South Island.

Haddock, it must be remembered, are caught by the trawl chiefly, though fish taken with the line are supposed to be preferable. The long lines used for haddock fishing off Norfolk are above 370 fathoms, as the fish are generally found near the bottom. If the New Zealand haddock is a deep-sea fish, its scarcity is at once accounted for. The Billingsgate costermongers cure the haddock in large quantities in the neighbourhood of Camberwell and Kennington. The haddocks are brought into an enclosure, and boys and girls cut off the heads and tails, split them open, clean them, and plunge them into the pickling tubs, where they soak for three hours, and then the "skewering up" process begins, and through each fish a peeled rod is passed until the rod is full; they are then laid on ledges in rows, and a fire is kindled underneath, which is kept smouldering by the judicious application of sawdust. The "curing-house" is now closed up, and when the fish are sufficiently turned of a yellow colour, they are considered to be ready, and six to eight hours is sufficient time for a skilled curer to split, salt, and smoke a load of

haddocks fit for sale. Those from Finnan, near Aberdeen, have obtained a great reputation. All at first were smoked over a peat-reek, but the demand becoming very great they were cured in special buildings erected for the purpose, and smoked in large numbers over burning fir branches or burning sawdust. The haddock in legend divides the honour with the Dory of being a descendant of the fish from the mouth of which St. Peter drew the tribute money. It is sufficient on this head to say that neither the haddock nor Dory are found in the waters of the Lake of Gennesaret. Yarrell mentions a haddock, caught in Dublin Bay, 16lb.; and Couch records the capture of another, 25lb., so we can well imagine haddock in our waters 4ft. in length. About 45,000,000 haddocks are annually caught on the New England coast.

HAKE (*see* Flat Fish).

HAKU (*Seriola Lalandii*).

Length, about four times that of the head, or four and a-half times the height of the body; snout long; from two to two and a-half times the diameter of the eye; ventrals moderate, the distance between their base and that of the anal being from two and a-half to two and three-quarters their length; maxillary reaches rather beyond the anterior margin of the eye.

Above steel blue, below white.

The haku of the Natives is the king-fish of Wellington and the yellow-tail of Australia. In the months of January and February in each year large shoals of this fish visit Cook Strait, and occasionally enter Wellington Harbour. They are generally of two distinct sizes, the smaller about 6lb. weight and 20in. long, and the larger about 4ft. in length and weighing about 40lb. The flesh is very rich and well flavoured, but, like all fishes of this class, must be eaten quite fresh. These fish are often caught in moki nets, to which they do great damage. They also drive on to exposed beaches, several of them being generally cast up together. The Natives value them very highly, and eagerly search the coast for them at the proper season, and have been known to carry choice specimens far into the interior as gifts to their friends. This species has a wide range, being found on the high seas of the Atlantic. In New Zealand it is not mentioned as having been seen farther south than Cook Strait, but in all probability it must occur along the whole of the west side of the island. In its habits it is migratory and gregarious, like the tunny.

In the Auckland district they are not as plentiful as kahawai or schnapper, but they are to be caught outside if fished for, and are occasionally to be seen in Mr. Williams's (the fishmonger) shop. In 1877 Mr. Thompson wrote: "The king-fish is only occasionally a visitor to our shores. A few are caught every summer;" but in the year following, he added, "No king-fish visited the coast this year;" and, in the table recording his three years' observation, the haku is absent altogether. They were in the Dunedin market but one day in three years.

"There are very few well-practised fishermen who are desirous to catch more than half-a-dozen large king-fishes in succession. They do a fair day's work when that is accomplished.

"If you are fishing in the harbour, and the king-fishes are about, procure if possible a live yellow-tail or mackerel; pass your hook through one of those alive above the tail, so that it will not be disabled too much; put out your line that it may be able to swim away, and when all other bait has failed the king-fish is almost certain to secure this. When the king-fish are in good condition and properly fresh, the belly part cured and smoked is far superior to any of the imported fish cured in that way; and that portion cured alone, and used immediately, before it gets too salt, boiled, and served up with egg sauce, is a choice *morceau*." In this manner writes Mr. Hill, as quoted by the Rev. Mr. Tenison-Woods.

HALF-BEAK (*see* GAR FISH).

HAPUKU (*Oligorus gigas*).

The first on the list of marketable fishes is the hapuku, or whapuku of the Maoris (*Hectoria gigas* of Count Castelnau), or habuka, as the name is generally pronounced by Europeans, who, in the south, apply the name groper to the same fish. It is also occasionally called the cod-fish, which is altogether erroneous, as it is more properly the representative of the sea-perch of European seas.

This fish has a peculiar interest from its close affinity to the famous "Murray cod" (*Oligorus Maquariensis*), which inhabits the rivers in the interior of the Australian Continent. The hapuku, however, never enters fresh water, but is a deep-sea fish, though not generally captured far from the coast. Round exposed rocky capes and islands, that rise in 20 to 50 fathoms water, with patches of sandy bottom, appear to be the favourite feeding-grounds of this fish during the season, and on nearly every part of

the New Zealand coast, where such conditions prevail, the hapuku may be obtained from November to May at the proper time of the tide. During the winter season they are seldom caught, as they probably leave the coast for deeper water. In the month of July Dr. Hector, however, caught many of them far up the Sounds on the west coast of Otago, in 50 to 60 fathoms of water, heavy with roe, for the purpose of spawning; for at this season they appear to crowd up to the fresh-water falls by which the rivers often discharge into the deep sea in this wonderful region. Hapuku fishing is excellent sport, the average weight of the fish being about 45lb., but occasionally large specimens, reaching to 130lb. weight, are caught. The head and shoulder-cut of this fish is most dainty food, and the flesh of the remainder is well adapted for pickling, and may become a valuable article of commerce. The hapuku in the northern parts of the Colony is of two kinds, but whether there are different species has not been determined.

Hapuku fishing in the North has been thus described by Mr. John Munro: "I had some little experience with the hapuku. For the first two years and a-half after I came to the country I was lying idle, sojourning at Whangarei Heads, waiting to get land for myself and passengers, and opening the way for others to follow; and during those two years and a-half I made nineteen voyages, in a small boat I had brought with me from Nova Scotia, to the Hen and Chickens, fishing hapuku for family use, as well as to kill time, or for pleasure if you like, and seldom, unless interrupted by storms, missed making fine hauls of that superior fish; on one trip, particularly, I took fifty-two hapukus home, and caught one with my own hands that weighed 90lb., and I met with persons who had seen larger still. If a person like myself, going out when fancy led me, without any experience of the tides, appetite, or habits of the fish, could catch such large lots in so short a time, what would an experienced fisherman catch, who would be for months stationed at the place. I made these trips in all seasons of the year, and had ample chance of observation; and I can say that, notwithstanding my long connection with fisheries in Nova Scotia for a series of years, I never saw in that country the sea more alive with fish than I have seen around the Hen and Chickens, where in fine weather were constant shoals of fish, stretching as far off as the eye could see in every direction, and on a calm day myriads of various sorts could be observed passing and repassing under my boat."

Captain Fairchild writes: "They can be caught in any quantity at the French Pass, Pelorus and Queen Charlotte Sounds, about the Bay of Islands, the Hauraki Gulf, and the Bay of Plenty."

Mr. Pearson says of the hapuku, on Stewart's Island: "Smoked and salted it is excellent. It is of such large size, and its flesh so firm and compact, it can be cut and cooked like beef steak." It is found in the Dunedin market some 150 days in the year. It is a good fish to can, Mr. Wilson says, and is to be found in abundance in the Hauraki Gulf, though not in the Kaipara, but abounding off Raglan.

As the manner in which the cod fish is cured would be suitable for the curing of hapuku and other large fish in New Zealand, the description of cod curing in Canada, given at the Fisheries Exhibition by Mr. Louis T. Joncas, one of the Canadian Commissioners, is here reprinted. He writes:

"A fishing establishment generally constitutes a small village by itself. On some of them the visitors can count no less than 120 buildings, in the centre of which, in an elevated position, is the house of the chief of the establishment. The stage, which is the most important building in a cod-fish curing establishment, is placed as near as possible to the beach. Some establishments have four or five stages. They are large wooden buildings, measuring generally 80ft. by 50ft., at one end of which is a wharf called the stage-head, extending far enough into the sea for boats loaded with fish to come alongside of it at low tide. The flooring of the wharf, formed of poles of fir or spruce, is divided into compartments, into which the fishermen on their arrival with boat loads of fish, toss them one by one with an implement called a pur.

"At the end of the stage nearest the wharf are the tables on which the cod is dressed. In the middle is a passage with a level floor of strong planks, on which the shoremen can wheel with ease their barrow loads of salt or fresh fish. On each side are places for piles of fish, for salt, and for troughs to wash the fish in.

"In the Canadian establishments three men are employed in the operation of dressing cod—namely, the cut-throat, the header, and the splitter.

"As soon as the cod has been landed on the stage, and put on the tables, the cut-throat, armed with a two-edged knife, seizes the fish, cuts its throat, and, having opened it down to the navel with a single stroke of his knife, passes it to the header. The header detaches the liver, which he throws into a barrel placed near him, and with the same hand tears out the entrails, after which, with his left hand, he cuts off the fish's head. The splitter now seizes the fish, and with a single stroke of his knife he removes the back bone.

"From the back bone of the fish is taken that delicious article of food which is well known as cod-fish sounds. These sounds are either salted, and packed in barrels, and sold in the local markets, or dried and sold to isinglass manufacturers.

"The head of the cod is salted for local consumption; but I regret to say that thousands of tons of entrails, offals, and even cod-roes are yearly thrown into the sea and wasted, whilst they could be converted into a good guano if we had manufacturers of this article on our coasts.

"From the hands of the splitter the cod passes into those of the salter, who places it on a pile, spreading it carefully with the flesh up, and with a wooden shovel scatters a layer of salt over each row. The salter's art lies in putting on each fish just salt enough to make it keep well, but not enough to burn it.

"The cod is left piled in this way for four, six, or eight days, according to the quality of the salt. Then the fish is carefully washed in large troughs, until all the salt is washed off, when it is put in piles again on the stage, in order that the moisture may drain off from it. After a day or two, if the weather is favourable, the fish are spread out one by one on flakes, in order that by exposure to the action of the sun and air they may be deprived of all the water they contain, and be reduced to that dry state in which they may be preserved for several years even in hot climates.

"The small fish is put on flakes about 3ft. high, parallel to each other, with space of 4ft. between, to enable the men in charge of the fish to move round them.

"The large size fish, containing more water, being thicker, and consequently more difficult to dry, is placed upon large flakes, 100ft. square or moıe, 10ft. from the ground, and as much as possible built along the beach, where the heat of the sun is always tempered with a gentle breeze from the sea.

"The first night after the fish have been put out, they are merely turned over flesh side down; after that they are gathered every night into piles of twenty or thirty each, and every morning they are spread out with the flesh up.

"When, sometimes about the middle of the day, the sun gets too hot, the flakes that are fixed on a pivot are turned to prevent the fish from being burnt, or the fish is covered with small fir and spruce branches.

"When there is a large quantity of fish on the flakes, the man who, in each establishment, has the superintendence of the operations of curing the fish, must be always on the look-out, watching the sky, and looking to every part of the horizon to see if clouds that threaten rain are gathering. At the least appearance of rain, or of a shower, orders are given to gather up the fish. The scene then is lively. The chief agent, bookkeepers, clerks, carpenters, blacksmiths, everybody in the establishment, go to work, and, when they have done, each goes back to his own business satisfied and free from anxiety, for the cod, when placed in piles with its skin up, cannot suffer from the rain, unless the wet weather lasts very long.

"When the cod is sufficiently dry, large round piles of it are made, containing as much as 100 quintals each, covered with birch bark, and pressed with heavy stones. By the pressure of these stones it is deprived of the little moisture that remained in it. Before it is sent to market it is spread out again on the ground, covered with fine gravel, during the warm hours of one fine day to give it its lasting 'sunning' or 'parting sun.'

"In fine weather, and during the dry season, when westerly winds predominate, cod is easily cured, and made of the first quality. It is not so when easterly winds prevail, and bring upon our coast mist and rain that last for weeks. Our fishermen are then in the greatest state of anxiety, and, in spite of every possible care and precaution, they frequently see the fish, which it has cost them so much toil and exposure to danger to snatch from the sea, spoiled before their eyes, without its being in their power, by any means whatever, to obviate the destructive effect of the dampness, for, once the fish has been exposed upon the flakes, it cannot be taken in the stores until it is perfectly dry.

"It is, I think, on the coast of Gaspe, in the province of Quebec, where the effects of the mists generated by the Gulf Stream are least felt, that the finest cod in all America is cured. This is well known in the markets of Spain, Italy, and Brazil, where it is generally sent.

"In order to guard against all risks from the weather, attempts have been made to dry cod artificially, but so far it has not succeeded as well as was expected, and I am of opinion that the agency of the sun and air are the best that can be employed for the drying of cod-fish."

Sir Ambrose Shea says: "The curing of fish requires much care and judgment, the weather being a very important factor in the operation. Unbroken sunshine is not desirable, while a long continuation of wet produces deterioration of quality; the best cure is effected when the weather is variable. It is not more

necessary that the fish should be exposed to the sun to dry than it should be piled and left in bulks to be gradually matured. Hence the reason for varying weather being desirable. Newfoundland sends to Brazil, Spain, Portugal, Italy, and the West Indies some 75,000 tons of dried cod-fish annually."

Salt cod-fish is no longer sent to the best markets in bulk, but the skin and bone are removed, and the fish, in neatly cut strips, is packed in boxes or in tinfoil-covered packages. This has led to a large increase of sales.

HAUTURE (*see* Horse Mackerel).

HIWI HIWI (*Chironemus Fergussoni*).

Height of body one-fourth the total length, and five-sixths the length of the head; diameter of the eye equals the orbital interspace, and is one-fifth of the head, and one-half the snout, which is pointed, with fleshy lips; gape extends to the vertical of anterior nostrils, which have a double fringe; form of body elongated, with convex profile, the orbital interspace being concave transversely; præoperculum rounded entire; operculum with two blunt spines and sub-opercular flap; cheeks with small scattered scales imbedded in the skin, which is minutely punctate. The length of the pectoral, which is pointed, exceeds the height of the body, the lower rays being stout, and flexible, and free from the membrane; the first and fourteenth are very short, the fifth is longest, and is two-fifths the length of the head; spinous and soft portions nearly equal.

Scales cycloid, the largest being half the diameter of the eye, those on the sides having a bright yellow spot in the centre of each; teeth strong, viliform, in broad triangular patches; vomerine teeth minute.

Body marked brown and yellow, like tortoise-shell; belly yellow; fins yellow, with dark bars. The length of the specimen from which the above description was made was 9½in., and the height of the body 2¼in.

It is highly prized by the Natives as a food fish, who say it is principally caught about the East Cape and Tologa Bay. Plentiful also in the Bay of Plenty. They describe it as a "rock fish," freckled, with white spots, and often caught in "white" water. A thick fish, of the length of a man's hand, and resembling the rock-cod. It takes the hook, and is occasionally caught among or with tarakihi.

HORSE MACKEREL (*Trachurus trachurus*).

Height of the body is about one-fifth of the total length, which is about four and a-half times the length of the head; the snout is longer than the diameter of the eye, which is one quarter the height of the body; lower jaw longer; the maxillary reaches to, or a little beyond, the vertical from the anterior margin of the eye; the lateral line becomes straight under about the fifth ray of the soft dorsal; pectorals reach beyond the commencement of the second dorsal.

Back, shining bluish green, lighter on the sides; belly, silvery white; a black blotch on the posterior margin of the operculum, and a darkish patch on the upper anterior edge of the pectorals; iris, purplish.

This is the hauture of the Natives, and the scad of the Northern Hemisphere. It has a very wide range, being common to the seas of Britain and New Zealand. This fish appears in Wellington Harbour about the end of November, and is one of the commonest offered for sale throughout the summer. Its form is somewhat like the true mackerel, but the line of armed plates along each side at once distinguishes it from the more valuable and rarer fish. Immense shoals of scads are occasionally driven on the beaches round the harbour by their impetuosity when following their prey into shallow water, or from their sufferings caused by an irritating isopod crustacean that infects their gills at this season. Their usual length is about 13in., but occasionally they are of much larger size, there being probably two distinct forms included under this specific name, which in that case should only apply to the larger kind. This fish is not mentioned as occurring in the southern provinces, but I noted a few on the West Coast at Martin Bay, and at Dusky Bay.

They are seldom caught in the Auckland waters; but are seen at odd times at the end of the Queen Street Wharf.

The Tasmanian Commissioners say the horse-mackerel appear in their waters, in immense shoals, between January and June, and might with proper appliances become the source of a very valuable industry. Their appearance in very large shoals is an indication of the presence of the much prized king-fish. A fisherman stated, in evidence: "When the horse-mackerel are very abundant, the king-fish are also abundant. When the main body of the mackerel disappear, the main body of the king-fish appear to follow them." "The young," Mr. Johnston says, "are seen all round the bays of the upper waters of the Derwent during the autumn." Another witness stated that they were caught formerly in large numbers by the seine, and were "a good marketable fish when brought to market in small quantities."

Mr. Ramsay, in his paper on the food fishes of New South Wales, writes: "The yellow-tail (*Caranx declivis* of Richardson), which is now generally admitted to be the young of *Trachurus trachurus*, is very abundant in all parts of the harbour. It is always in demand for bait, and is a good edible species. Adults, reaching a length of 15in., are occasionally taken on the coast, and sometimes also far up the harbour during the spawning season. The adult fish (the report of the Royal Commissioner on fisheries in New South Wales says) is seldom seen in the harbour, but is said to pass along the coast in shoals at or about midsummer. It is most probable that this fish spawns in the inlets and harbours of the coast, from the fact that the young fish of 5in. to 6in. in length are always to be found in such localities. The very young fry have a most extraordinary and ingenious way of providing for their safety and nutrition at the same time; they take up their quarters inside the umbrella of the larger medusæ, where they are safe from their enemies, and are, without any exertion on their part, supplied with the minute organisms which constitute their food by the constant current kept up by the action of the curtain-looking *Cilia* of the animal."

From the same source we are told that: "Like all deep sea fishes it prefers live bait, and is readily caught by an artificial one over the ship's counter. The usual method is when the vessel is going through the water at three to five knots to put out a line with an artificial bait, and to have a small bridle of twine fast as well as the line on board; the bridle being the first to have a strain is easily snapped when any additional weight is put on it, consequently, being an indicator, soon tells when anything is fast. By this means a line can be set which requires little attention except when a fish is on."

In Cornwall and the Scilly Isles they are split and salted; also in the North of Ireland, where they are known as crake herrings. Parnell says: "The flesh is considered, by some, inferior food; by others, as superior to that of the mackerel. It is firm, of good flavour, and wholesome." Yarrell writes: "They possess a portion of the flavour of the mackerel, but are not so fine." Pennant, that they are "in best season when first coming off the coast."

The scad, it is said, in its adult form, is more solitary in its habits than when young, and swims low. In the cold weather hey retire to deep water. Very uncertain in their migrations. he true mackerel and the horse-mackerel, Mr. Couch says, do ot intermingle much, but sometimes they are caught together in rge quantities. They pass up the English Channel, he states, ring the spring in the deep water, feeding at the bottom; but summer advances they approach the shore, swimming high,

its movements are slow they become accelerated when it desires food, which it pursues by a sort of succession of jerks. It is a great wanderer, and in the winter months appears to retire to deep water, returning in the spring in excellent condition. It seems to prefer during the warm months rough ground to deep water, as well as sandy bays where small weeds and fishes abound." It has a very voracious appetite. It gets so gorged that it is sometimes taken by the hand. Its spawning time is not known.

Couch mentions that, in the opinion of some fishermen, the Dory employs its long filamentous dorsal appendages as a decoy, similar to what takes place in the angler or frog-fish; making a depression in the sand; or hiding in rough ground, it waves its fishing-lines, or suffers them to float about like worms, and meditates a successful result from this artifice in the shape of some misguided victim.

Many cases of *whitlow*, Mr. Day writes, involving the loss of joints of fingers, are occasioned from injuries inflicted by the spines placed at the base of the dorsal and anal fins in these fishes.

A length of from 18in. to 22in., with a weight of from 12lb to 18lb, Mr. Kent says, is the largest size the Dory obtains.

Different opinions are entertained as to the quality of the Dory as a food fish. Some rank it after the turbot. Sir Joseph Banks placed it among the most valuable fishes, as it required no sauce. It is said that the flesh is better after the fish has been kept a day or two. Generally cooked, similarly to a turbot, boiled, and served with shrimp or lobster sauce. Quin recommended that it should be boiled in sea-water. Vernier said: "It is not good to eat too much of, because it breedeth gross and phlegmatic juice."

KAHAWAI *(Arripis Salar)*.

Length about four and a-half times the height, or nearly four times the length of the head, which is five to seven times the length of the horizontal diameter of the eye; præoperculum serrated on the inferior and lower part of the posterior margins; sub and inter-operculum with scales; fourth dorsal spine the longest; last soft ray of dorsal and anal considerably elongated; a long soft double spinous process in the upper part of the axil of the pectorals; caudal forked.

Above, greenish grey, spotted with lead-blue on the back; belly, white; a pale lead-coloured streak from the pectorals to the caudal, and a black spot in the axil of the pectorals; fins, dusky; lower margin of caudal white; iris, bright yellow.

Abundant all round the coasts, and in the mouths of rivers; it sometimes ascends the Waikato for about 30 or 40 miles. Grows to about 2ft. or 2½ft. in total length.

This fish is frequently termed the native salmon, from its elegant form and lively habits, in which it resembles the true salmon. During the summer months these fish—which reach the weight of 7lb., but are more usual from 2lb. to 3lb.—visit the coast in great shoals, especially frequenting the mouths of streams. They afford good sport to the angler, as they rise to an artificial fly, and are readily taken at sea with spoon-bait. When of large size the flesh is rather dry and tasteless, but the young fish, when under 1lb. in weight, and quite fresh, are very delicate and well flavoured, especially when boiled in water acidulated with vinegar. In the early stage of their growth they are spotted on the sides like trout, but with fainter colours. Kahawai is one of the early fishes in spring, at which season it follows voraciously the young fry of the aua, or sea-mullet. It is a fairly good fish for preserving in tins, and has been successfully prepared in this manner by Mr. Liardet, of Wellington. The kahawai appears to be a migratory fish, avoiding only that portion of the coast that is washed by the cold south-east current.

It is not a frequent visitor to the Dunedin fish market, as it only averaged three days a year for three years. Mr. Arthur also says they ascend rivers some distance from the sea.

Mr. Johnston, of Tasmania, says the kahawai is brought to market in the greatest abundance all the year round. It is almost certain, as stated by Professor McCoy, that the *Arripis truttaceus* is but the immature form of the *Arripis salar*. In the young state they are barred or spotted, the markings becoming fainter as they increase in size, and disappearing altogether in the mature forms.

Mr. Ramsay, of Sydney, writes: "If properly treated, after the manner of the cod and ling, and from its large size and the prodigious numbers in which it congregates, it is capable of affording a large quantity of valuable food, either for home consumption or export." Mr. Wilson considers that it should be put up in oil or salted in barrels. It is found in the Bay of Plenty in January and February, and is readily caught with a glistening bait.

Of late years the fishermen in Sydney have been trying to devise a drift or purse-net for the capture of kahawai, but, up to a comparatively late date, they had not succeeded.

The Rev. Mr. Woods writes: "This is the most common of all Victorian fishes, and the young only take the adult livery when they are at least 1ft. long. During the cold months of winter the adults are hardly ever seen. The flesh has often a dull pinkish tinge, which may be one of the reasons for the popular application of the names 'salmon' and 'salmon trout' to this fish, which it does not resemble in the least. It seems to 'school' about the latter end of summer."

KANAE (*Mugil Perusii*).

Length four and two-fifths that of the head, or three and three-fifths the height of the body; interorbital space slightly convex, twice the diameter of the eye, which goes four and a-quarter times into the length of the head; snout rather longer than the diameter of the eye; mouth broader than deep, angle formed by mandibles rather obtuse (100°); upper profile slightly arched; præorbital, emarginate; upper lip not very thick; maxillæ not covered by præorbital; free space at the chin; between the mandibles, lanceolate; an adipose membrane covers one-half of the iris anteriorly and posteriorly: spinous dorsal half way between the snout and the tail, higher than the soft, which commences over the fourth ray of the anal; pectorals are about two-thirds of the length of the head, and when closed do not reach to the spinous dorsal, they are placed very slightly above the middle of the body; fins scaleless; a long pointed scale in the axil of the pectorals; second dorsal and anal of about equal heights, much less than the caudal, which is deeply emarginate, and uniform in colour; about twenty-six scales between the snout and the dorsal.

Above, plumbeous blue; below, silvery.

The grey-mullet is a very familiar fish to residents in the northern parts of the Colony, where it forms a staple article of food among the Natives at certain seasons, and is one of the commonest fish sold in Auckland. Kanæ have of late years been commonly obtained on the West Coast as far south as Porirua, at the north entrance of Cook Strait, and occasionally enter but are not common in Wellington Harbour, probably because a rocky coast and deep water are not suitable to their habits. The kanæ frequents the tidal rivers, going out to sea in summer and returning in the winter in immense numbers. They are captured generally with nets, but they also take the bait. The Natives frequently capture them on still, moonlight nights, by paddling their canoes close to the banks of the streams; the fish are startled by the beat of the paddle, and, leaping up, fall into the canoe. This mullet excels all other New Zealand fishes in richness, and is now dried and smoked in large quantities for sale in Auckland, where several extensive establishments also exist for tinning this fish. In this form it is highly esteemed, rivalling the American tinned salmon in the market.

Mr. Munro, in his evidence before the Joint Committee on Colonial Industries, says, *inter alia:* "When I went to Whangarei Heads, seeing shoals of mullet in the harbour, I turned to and made a seine, a net on the Nova Scotian principle of catching mackerel and similar fish, which cost me about £30, and which was about 90 fathoms long. What fish was I not to catch with this net? Not only enough for myself, but for my neighbours, and to

spare; but, after spending a season with it in every way, I could not catch enough mullet with it to keep a small family supplied with fresh fish. I gave it up in disgust, and ordered a net from London. About its success I will only say that I went out with it only one night since I was here last year, and took 700 mullet home in the morning." They can be cured, he adds, by salting in barrels. A favourite method of preparing the mullet for market is to dry and smoke them. The fish are cleaned and flattened out, and smoked for about twenty-four hours. They are then put into a box, carefully packed in layers, with a sheet of paper between each layer. The box is nailed up, and the fish are ready for export.

In a paper which Mr. Wilson contributes, he says: "The habits of the mullet form quite an interesting study. It has never been known to take a bait, and appears to live entirely by suction. On the mangrove flats and swamps there grows a peculiar grass and marine plant. This the fish takes in its mouth and pulls it through its teeth similar to the manner in which asparagus is eaten. A thick green slime adheres to the grass from the action of the tide, and, on opening the mullet, large quantities of the slime and also sand are found in their entrails, and seem to be their principal if not their only food. In the stomach is to be found a thin coating of skin of a jet black colour, adhering firmly to the fat, and when the entrails are removed this skin remains fast and retards the process of cleaning very materially."

Mr. Howes, writing from the other side of the globe, tells the same story much in the same way. He says: "In addition to the multitude of the small organisms living at the bottom, the ever-recurring deaths at the surface bring about a constant subsidence of organic matter; and, while such a fish as the mullet does not therefore get a bad meal in the end, this process of decay is a factor in the food of fishes, the importance of which is much under-estimated. The alimentary canal of the grey mullet is modified accordingly, and, as a deal of vegetable matter must be consumed, we find, as is often the case among vegetable feeders, that the intestine is long and coiled, the stomach powerful and gizzard-like, and pyloric appendages are present. An exceedingly curious and inexplicable feature is seen in this and many other fishes, in the presence of a black pigment, giving the lining membrane of the body cavity a sooty appearance." [It should be stated that the details taken from the English writers about mullet refer to a different, though allied, species to ours.]

Mr. Wilson, continuing, writes: "On boiling the entrails we get a splendid oil similar to cod liver oil both in smell and taste. The mullet, as a rule, travel in large shoals. When a shoal is coming in with the tide the fishermen always look out for the fish

jumping, and also listen for a peculiar noise which they make coming along the surface of the water, somewhat similar to that of a steamer's paddles. The fish follow on with the tide to the various creeks, rivers, sand-banks, or mangrove flats, their usual feeding grounds; but they are occasionally to be found upon the very edge of the ebb tide with their backs exposed to the sun, and large hauls have often been made in from 4in. to 12in. of water—sometimes as many as 2,000 at a haul, averaging in weight from 1lb. to 4lb. Immediately the tide turns the mullet commence to return seawards, when the fisherman will speedily place his nets across the mouth of the river or outlet, when the fish, finding their way blocked, in some cases turn back, but, finding the tide leaving them and no other means of escape, they will leap right over the nets, only a few being secured."

"At Mevagissey, in Cornwall, a shoal entered the harbour," Mr. Day says, "and, having been perceived, the entrance was at once barred with nets. The mullet first tried to jump over, but a net was raised to bar that route. The water was very clear, and the fish were seen to swim round and round to try and get an exit. Next they attempted to get under the foot-rope; at last one made a push and got meshed; when this was done another came and laid beside it, and nothing could drive it away. In short, all but these two escaped." The reader will see how the statements of Messrs. Wilson and Day resemble each other. The Romans had a proverb "Dull as a mullet," and Mr. Wilson compares them to sheep. "The mullet," he continues, "is to be found in great abundance on the west coast of the North Island, but is principally taken by the Natives. Fishing on the West Coast is not much in vogue with the Europeans, on account of the bar harbours, and the heavy surf beating on the beach all along the coasts from heavy westerly winds.

"The Maoris are the only fishermen who bring supplies to the factory. [This paper was written when Mr. Wilson had a fish-curing factory at Helensville, Kaipara.] Their mode of capture is as follows: They have a net made of New Zealand flax, and one of the Natives takes the end of it and wades out through the surf up to his neck, and in this manner surrounds a lot of fish. Then three or four other Natives spread along to assist him, and by their united effort they scoop the fish on to the beach out of the surf in large quantities. Several of the fish in the haul will weigh from 6lb to 7lb. The largest hauls taken in this way are some 200 dozen, and the nets often break with the strain. The mullet on the West Coast are the deep sea mullet, and much larger and of better quality, and in larger shoals than those on the East Coast.

"The spawning season is during December, and the fish go up into shallow water to spawn, and usually deposit it on rocks,

snags, and sand-banks. The spawn of one fish will often weigh as much as three-quarters of a pound. The Maoris state they have seen shoals of mullet from 1 to 2 miles in length, and covering a very considerable width, the surface of the water being quite black with them. I have found that there is no New Zealand fish which can be put up in tins fresh so well as the mullet. Its oily and rich nature makes it a general favourite with the public, and many epicures pronounce the fish quite as good as salmon, and superior to any other smoked or put in tins."

Mr. Wilson's remarks suggest several matters. "In Italy," Mr. Day says, "the hard roe of mullet is converted into cakes termed *bolarge* or *bolargo*, which are prepared by washing and sprinkling with salt, and pressing between two boards. This may be smoked or sun-dried, and is considered a good appetiser to promote thirst. But in India the same article is somewhat similarly treated, and considered excellent for curries." That *bolargo* was formerly eaten in England the readers of Pepys will remember, as the gossip says: "Sir W. Penn came out in his shirt on to his leads, and there we stayed talking and singing and eating *bolargo* and bread and butter till twelve at night, it being moonshine; and so to bed very nearly fuddled."

As to the mullet not taking bait, all history is against Mr. Wilson (with whom Mr. Masefield agrees), and tradition too, from the time of Ovid at least, who says: "The mullet with its tail beats out the pendent bait, and snatches it up when thus struck off." The Rev. Mr. Houghton, in his essay on "The Natural History of Commercial Sea Fishes," tells us mullet are sometimes caught with an artificial fly or gentles, or a small red worm. Herrings' roe has been recommended, and I have read somewhere that an oyster is irresistible.

Mr. Masefield supplies the following details about mullet fishing and curing at Kaipara. He has three boats employed, with two men in each. The two boats and gear he values at about £100 per boat. The nets in use are 100 fathoms in length, and some 6ft. deep. There would not be the slightest trouble in doubling the output were there a ready market for the canned fish. On an average one mullet is put up in each tin. Unless the fish are carefully canned the loss is very great. He has known consignments in which at least 50 per cent. turned out bad. The roes are thrown away. Writing to the Hon. Mr. Stout, in April, 1885, he said: "We have now got in working order the steam retorts, and all the latest American inventions, to enable us to turn out a first-class article. We are canning now between 500 and 600 dozen mullet weekly; we are also smoking them. We

are also canning schnapper for export, chiefly to New South Wales, as they are highly thought of there. We have at present twenty-seven hands engaged canning fish. We find many people in the Colony prefer our mullet to the American salmon." Mr. Froude, it will be remembered, compared the mullet with the best English or Scotch salmon.

KELP FISH (*see* BUTTER FISH).

KING FISH (*see* HAKU).

LAMPREY.

There are two forms of the lamprey in New Zealand, which are thus described:

Geotria Chilensis.

Skin on the throat not much dilated; the outer lobes of the maxillary dental lamina are broad, with a sharp convex edge, the inner narrow and pointed; mandibulary lamina crescent-shaped, with numerous obtuse points; suctorial teeth in numerous series, so close together that the teeth have the appearance of imbricated scales; a series of larger broad scale-like teeth round the mandibulary lamina; suctorial disc not dilated, circular; first and second dorsal fins widely separate from each other.

A specimen in the Auckland Museum is 22in. in length. This species has a broad band of green down each side of the back, the medium line and the whole of the lower surface being pale brownish white.

Geotria Australis.

Skin on the throat dilated into a large sac; maxillary lamina thin, crescent shaped, with four sharp teeth, the middle pair of which are only half as broad as the outer; mandibulary lamina very low, slightly sinuous; suctorial teeth in numerous series, rather distant from one another; anicuspid small, those nearest to the mouth rather larger; only one transverse series of very small teeth between the mandibulary lamina and the posterior lip, which, as well as the remainder of the margin of the disc, is beset with numerous broad leaf-like fringes; suctorial disc subtriangular with the lateral lobes very broad; dorsal fins widely separated. Uniform blackish.

Captain Hutton, who has described it, says it is found in Stewart Island.

Representations of both kinds are found in Plate 12, vol. 5, of *The Transactions of the New Zealand Institute.*

"Most of the larger rivers in New Zealand," Dr. Hector writes, "are visited early in the summer by shoals of lampreys, which are stated to be excessively delicate and well flavoured." It is of some interest to know that the same species of lamprey (*Geotria Chilensis*) visits the rivers of Chili and Western Australia. They are greatly esteemed by the Natives, who call them piharau, and used to pot them in large quantities. Maori chiefs, as well as Henry I., have died from a surfeit of lampreys, the chiefs having the pick of large catches of all kinds of fish set apart for them.

The first-mentioned species are abundant in the Waikato, and are found, the Natives say, in rough mountain streams. "Of an eel-shaped form," writes Mr. Day, "with, in the adult, a circular mouth, destitute of true jaws, and capable of being employed as a sucker, the fish can attach itself to any fixed object, and no muscular action is necessary to prevent its being carried down stream by the current." It is necessary to bear the construction of the mouth of the lamprey in mind to understand what the Natives mean when they say they see them "sucking their way up water-falls in streams in hundreds at a time." When thus found, a net is placed at the foot of the fall, and the fish being detached, fall into the net, and are thus captured. They are also often found in their eel-weirs. They ascend the Waikato (and probably other rivers), when the whitebait is also ascending. If cooked in a hangi, they have to be eaten with care, and a certain fluid they contain, the Natives say, must be expressed, or its effect will be similar to that induced by the eating of a certain kind of shark—the loss of the gourmand's skin. Cooked as Europeans would cook them, this apprehension would not be entertained. One cannot help feeling regret that the Maori knowledge of fish in this Colony has not been more carefully conserved. Mr. Day says: "They are often netted along with salmon and shad, but are usually obtained in weels laid at the bottom of the river, while they are mostly fished for at night. Those taken in wicker traps are considered more valuable than such as are captured in nets, as they do not roll themselves about so much, and consequently are less bruised. On warm, sunny days a person may be punted quietly to where the fishes are nesting, when they may be easily gaffed or speared. At each breeding place they are generally seen in pairs, and they form a furrow at the bed of the river for the reception of the ova."

The Tasmanian report has the following: "Abundant at certain seasons, clinging to the sides of perpendicular rocks under mill shoots."

Lampreys have been held in different estimation at different periods, and by different people. Henry IV. granted protection to ships which brought them for the delight of his consort; and John gave the Earl of Chester a good palfrey for a single lamprey. Gloucester used annually to send a lamprey pie to the Prince of Wales. Buttes, in his *Dyets Dry*, says: "It hath a most excellent relish, nourisheth passing well, increasing seed. A lordly dish. Somewhat slow of digestion, specially not boiled enough; naught for the gout or feeble sinews. Choake it with white wine, stop the mouth with a nutmeg, and the other holes with cloves; then fry it with nuts, bread, oil, spices, and white wine." Denison, who wrote 100 years earlier, says: "Lamphrey is never better than in May. And lamphern, its brother, is good from the 13th Mass to the day of our Lady's Annunciation."

LEATHER JACKET (*Monacanthus convexirostris*).

Body covered with small spiny but very distinct scales; length two and one-fifth times the height; snout rather produced, more than one-half of the height of the body, the upper profile straight, or slightly convex; gill openings under the centre of the eye, extending almost as far as its anterior margin; pectoral fin below the eye; dorsal spine placed over the hinder half of the eye, strong, much shorter than the head, armed both behind and in front with a double series of barbs, those in front being smaller and more irregular; ventral spine barbed, no spines on the tail.

Back, reddish brown; below, pale yellowish brown.

When fresh, this fish is of a dark greyish colour, with the dorsal and anal fins, as well as the iris, bright yellow.

This remarkably-shaped fish is very common in Wellington Harbour, and on other parts of the coast is not unfrequent. Though usually cast aside as worthless, it has really palatable flesh when the tough skin, from which it receives its trivial name, is removed. The Maori name for this fish is kiriri. In other countries, members of this genus are called trigger fishes, from the power which they possess of suddenly erecting the stiff spine on the back with a snap that holds it rigid without further effort. The usual size of the leather-jacket is about 11in. long.

The leather-jacket is not known in the Auckland market, but is common enough outside the harbour, at the Barriers, Whangarei, the Bay of Islands, and other places on the coast. The fish called by that name in Dunedin (*Agriopus leucopoceilus*) is a different fish altogether, belonging to a different family, and though palatable, with white firm flesh, according to Mr. Thompson, is seldom eaten. The leather-jacket proper, if it may be so called, has been found at Dusky Sound, and on other parts of the western coast of the Middle Island.

Reporting on *Monacanthus Ayrandi*, the Sydney variety, the report of the Royal Commission on Fisheries in New South Wales says: "It is said when skinned to be excellent food, but it is a most serious annoyance to the fishermen, infesting their favourate fishing-grounds, and cutting their lines. The plague of these fish seems to be on the increase, and unless some means can be found of getting rid of the fish, schnapper-fishing will have to be conducted with wire lines." In the Sydney fish the Rev. Mr. Woods says the skin is rough but velvety; the colour is brownish with three or four whitish longitudinal bands. It attains a length of 18in.

LEMON SOLE (*See* TURBOT).

LING (*Genypterus blacodes*).

Length equal to seven times that of the head, or nearly ten times the height of the body; length of the head eight times the diameter of the eye; barbels (ventrals) with the outer filament longer, about one-half the length of the head; head covered with a thick, soft skin.

Back, purplish, the rest reddish white, marbled on the sides with reddish purple; silvery; vertical fins margined with white.

"This fish is also known as the Cloudy Bay cod, and is exceedingly common in Cook Strait and on other parts of the coast to the southward. It is, however, seldom brought to market, not being as much appreciated for food as it deserves. It is a large fish, reaching occasionally 5ft. in length, weighs 15lb. to 20lb., and has a white, flaky flesh that takes salt well, and, being easily freed from bone, is well adapted for curing in the same manner as the cod-fish of commerce. It is in best condition in the beginning of winter. This is one of the fish that is cast up on the beaches outside Wellington Harbour, after heavy gales, in extraordinary profusion. It is very voracious, with powerful, well-armed jaws, and takes the bait greedily, so that large numbers can be readily caught."

It is unknown in the Auckland market, but is occasionally caught on the coast to the north of Auckland.

To the above little needs to be added, save that Captain Fairchild writes that in the Otago waters they are found in great quantities. The ling is highly thought of in Tasmania, and obtains a ready sale. They are usually caught, Mr. Johnston says, on a weedy or rocky bottom, in from 3 fathoms to 8 fathoms of water, with hook and line. They are sometimes captured on the surface. It would appear that, if in pursuit of prey they happen to broach on the surface, they rupture the air bladder, or sustain some other injury. They are only caught in numbers at odd times. Although classified there as *Genypterus Australis*, Professor McCoy is of opinion that they are not distinct from the New Zealand ling. The value of the fish in the market at Hobart is stated at 4d. per pound. Salted ling is a considerable article of commerce in Great Britain, especially with Spain and Italy. But, while writing of the *Genypterus blacodes* as ling, it must be remembered that the European ling belongs to quite a different family, and is not at all allied to the fish sought to be described; and the following details are inserted from the interest they may possess to persons who may be induced to experiment in curing our larger kinds of fish for exportation.

The causes of trade are curious, but in no instances more so than in the fish trade. The German prefers a herring to a pilchard, the Italian a pilchard to a herring. The explanation is given by the Lieutenant - Governor of the Isle of Man in this wise: "The Italian is usually a Roman Catholic; the Roman Catholics buy fish as food, and the Italian therefore purchases a rich oily fish like the pilchard. The higher classes in Spain buy cod, for the same reasons which make the salt cod of Newfoundland the usual dishes in English house holds on the first and last day of Lent. The German Protestant, on the contrary, eats his herrings, not as his chief food, but as a relish. He likes his herrings as he likes his hams, cured by salt, and uncooked by fire." The English ling trade with Spain comes from the days of Elizabeth.

When the ling is in season the liver is of a white colour, and affords a large amount of oil, which is used for lamps, medicinal, and other purposes. The roe is consumed as food or preserved in brine, and is often employed for attracting other marine fishes to localities where their capture would be facilitated. Ling split for curing should not be less, the curers say, than 26in. from the shoulder to the tail.

It is captured by hand lines and long lines. The ling fishermen in Galway remain out a week at a time, but seek nightly shelter. Ling and conger are often fished for together. The long lines, containing several hundred hooks, are baited night and morning. A slice of flat-fish, herring, cuttle, or conger, is generally used, which should be fresh.

Ling is prepared like cod; the head is cut off, the body then split, salted in brine, and dried, when it is ready for transmission. Coarse isinglass is made from the ling's air bladder, or "sounds," similar to that obtained from the cod.

MACKEREL (*Scomber Australasicus*).

Length two and three-fourths that of the head, or four and three-fourths the height of the body; snout one-third of the length of the head, and nearly one and a-half times the diameter of the eye; teeth distinct; caudal divided in the middle into an upper and lower lobe.

Back, shining bluish green, with spots and oblique stripes of darker, the stripes sloping downwards and forwards; belly silvery.

This valuable fish is well known as an occasional visitant in Wellington Harbour, being called by the Natives tawatawa. In colour, size, and form it closely approaches the common mackerel of England, and is very superior in delicacy to the scad or horse-mackerel, which is commonly called the mackerel in New Zealand. As the mackerel is a migratory fish, making periodical visits to the coast from deep water, it will, no doubt, become better known when regular fisheries are established. In Europe, the mackerel is obtained throughout the year, but is most abundant in early summer, and is caught either with a hook or drift-nets. In the north of Auckland the Natives make great preparations for fishing tawatawa at the time of new moon during summer, and capture immense numbers.

When in season, mackerel are often found between Cape Colville and the Great Barrier, and small shoals have been seen in Auckland Harbour. They are said to be abundant late in the spring about Whangarei and the Bay of Islands. The fact of the existence of the mackerel in these Southern waters is unquestionable. Mr. Johnston, of Tasmania, says: "The English mackerel is seen on the East Coast, occasionally in large numbers, each year moving in a northerly direction. . . They have been known to enter the Derwent in large numbers." The shoals are followed by the king-fish. They are only seen at irregular intervals.

The appearance of mackerel shoals is of more frequent and regular occurrence than generally regarded, or was at least in past years, as it was the usual Maori habit in summer to station men on cliffs to watch the shoals coming to land, in the same way as the "Huer," in Cornwall, is appointed to keep a look out for the appearance of shoals of these fishes, and to make signals to the

fishermen, who depart at once in the direction of the anticipated captures. Like other fish of the same family, the mackerel dies after leaving the water, and decomposes rapidly; from which fact, and its value as a food fish, legislative permission was given for its sale in Great Britain either before or after Divine Service on Sunday; while other fish, brought on shore on Saturday night, is expressly ordered to be sold on Monday morning.

Mr. Cornish gives some interesting details about mackerel in his paper on "Mackerel and Pilchard Fisheries." "Mackerel takes bait but shyly," he says. "Every five or six years they turn up in large shoals, which are intensely localised, and in the evening for an hour or two will take surface-bait greedily. I myself once cruising backwards and forwards over a little patch of ground where a shoal of this sort had located itself for about two hours, between five and eight each evening, for four days in August, took, on a whipping or light hand-line, and on a hook baited with a strip cut from an old white kid-glove, over 300 fish. Its habit of shoaling in the day-time taught me the curious fact that the shoal leaves behind it a distinct scent in the water, and that there are other inhabitants of the sea who quite understand what that scent means, and utilize it. A shoal of fish in the water looks at a distance like the shadow of a cloud moving steadily on. Each sort of fish gives a colour to the water which is peculiar to it, so that an experienced fisherman knows at sight whether the shadow of the cloud, which he knows to be a shoal of fish, covers mackerel, or pilchard, or herring, or sprat.

"Standing on a headland in Mount Bay I saw a shoal of mackerel come out of a sandy bay and go west. Shortly after I saw a shoal of porpoises come lumbering up from the south into the sand. When they came across the trail of the mackerel the latter were a good mile off on their way. The porpoises had no sooner got into their back water than they wheeled in their course and set off in full chase. In about three minutes they were in the midst of the mackerel, which were driving forward in one solid line of terror, making the water foam before them as they fled. Mackerel shoal in deep water as well as in shallow.

"Strictly speaking, the mackerel is not a migratory fish. It is in our seas all the year round, but in the season, for some unknown purpose, crowds from the deep sea in-shore. It never pursues, as true migrants do, any settled route. The fishermen have to search for their fish day by day. In the day-time the fish are taken by the school or shoal in shallow water by the seine-net—a net shot ahead of and around them. In the night-time they are taken by a drift net, a net shot over the boat's side, and fastened at one end to the drifting boat, which goes with the wind, or tide, or both."

The mackerel boats are from 15 tons to 18 tons burthen, costing, with the nets on board, £600 each. They are capable of going closer to the wind than any ordinary yacht. Their spread of canvas is enormous, and they live in very heavy weather. "If one of these boats," our guide continues, "is overpowered by the sea, she takes down her spars and makes them and her nets, and such of her sails as she can afford to risk, into a kind of raft, under the single shelter of which she rides out the gale; but an improvement on the raft is a floating anchor, which consists of a beam of timber, to which is attached another beam of timber, from which there trails away a perforated zinc can, which finds its place when at work in the cavity of a cone made of canvas fastened to a wooden hoop. When the boat is storm-pressed she lowers her masts, heads up to wind, and hoists the whole machine out ahead of her and makes fast to the first beam, and then, being deeper in the water than the machine, she drifts astern and down the wind, towing the anchor; the outer beam of the anchor stretches the canvas sheet, and is assisted in doing this by the cone which it is dragging mouth foremost. The cone meanwhile is receiving from the zinc can oil, which exudes from it and which the cone itself sends out in a fan shape. Thus an advancing wave first meets the oil, the effect of which we have heard so much of lately. It then meets and perhaps breaks against the forward beam, and then has to pass under or fall on the sheet, and, in any case, will reach the boat in a very enfeebled condition." Each boat carries a crew of seven men and a boy.

Mackerel being what may be called floating fish, or fish which swim at or near the surface of the water, in distinction to those which live at or near the bottom of the sea, are largely caught by drift nets well corked so as to make them float at the surface of the water. "They are not so deep," Mr. Holdsworth says, "as herring nets, but the train is very much longer, extending to as much as two miles and a-half in length. The meshes are larger than those of a herring net, there being usually 22 or 23 meshes to the yard, and in some places 27. Mackerel drivers follow their fish into the deep sea, and sometimes fish more than 30 leagues from the nearest land; and sometimes, when several boats are in concert, may remain out a week at a time, one of the fleet running for port each morning with the night's catch." At Rye there is a large mackerel fishery, where fixed nets, termed "kettle nets," are employed, each of which is over half a-mile in length, the poles to which they are attached being 12ft. high, while each contains three chambers or bights.

"When mackerel," Mr. Day says, "are in small and divided companies, hand-lining becomes more remunerative than netting, and greater success generally attends the employment of several lines used together, while several hooks are best on one line.

The favourite time for fishing with a bait is when there is a little ripple on the sea and a 'mackerel breeze,' which takes the boat along at a fair speed, while should the sky be gloomy so much the better." Almost any bait will serve—novelty often attracting the fish as it does our wood-hen. The French, when they take fish for salting, preserve them on board, and pack them in the hold.

The mackerel fisheries in the United States produced in the year 1880, about 132,000,000lb.; employed some 470 steamers, of from 60 to 100 tons each, and with an aggregate capacity of above 23,000 tons, with crews of fourteen to twenty men, and nets worth 450,000 dollars. Some of these steamers caught fish to the value of £5,000 or £7,500 a year. Mackerel were at one time largely caught by what was called "The Mackerel Hook Fishery." It was conducted in this way, Professor Goode stated: "The fishermen took on board a hundred or more barrels of a very oily flat-fish called the menhadden, something like the pilchard. They ground it up fine, and threw it out in great quantities. The mackerel would follow this for a long distance, and come up round the vessels like a flock of chickens to be fed. Then the fishermen had short lines, with hooks on the end, with which they caught the mackerel, and threw them on the deck, and with a crew of ten to fourteen men the catch would sometimes amount to 20,000 a day. That mode of fishing was carried on for a long time, but the purse-seine gradually came into use and displaced it. There was no difficulty in working it. The seines were from 70ft. to 150ft. in depth, and from 1,000ft. to 1,500ft. in length, and were worked by a special boat something like a whaleboat, and it was quite easy for a vessel to catch as many fish as could be cured in three or four days."

At first they used to give the surplus fish away or let them go, but now they have invented a kind of storage-net, which they hang out over the side of the vessel, and keep the fish alive in it, taking out at intervals as many as they could cure before they spoiled.

Mackerel may be boiled, fried, split and broiled, filleted, or stewed in wine sauce. The Cornish Sardine Company are now tinning the smaller fish in oil like the pilchard.

In the official report on the International Fisheries Exhibition we read, at p. 25, vol. 13, as follows: "Large shoals of mackerel annually visit the waters of New South Wales, and these shoals are practically unfished. There does not seem to be any clear reason why a large and profitable fishery should not take place for them; and the Commissioners of New South Wales would, I think, do well to carefully examine the modes of fishing for these fish practised in America and British waters." Acting on this hint the above information from the Fisheries Literature has been compiled.

MAKAWHITI (*Agonostoma Forsteri*).

Length four and two-third times that of the head, or five and a-half times the height of the body; interorbital space flat, one-third the length of the head; snout produced, one and a-half times the diameter of the eye; præorbital serrated; dorsal half-way between the snout and the tail; teeth on the jaws, vomer, and palate.

Back, shining blue and green; below, silvery white; fins, yellowish brown, finely dotted with black; caudal, blackish at the tip; iris, yellow.

This fish never attains to so large a size as the kanæ; it spawns in November. It is commonly called the herring by fishermen, but it is better to reserve that name for a true herring, which is found on the coasts, and will probably be brought into the market as soon as deep-sea trawling is introduced.

Called the sea-mullet in other places, but the makawhiti or aua by the Maoris. It is a common fish, Dr. Hector says, obtained at all seasons of the year by fishing from the wharves in the harbours. In Dunedin it is known as the mullet. "It is easily recognized from the true herring by having two fins on the back, the first of which has only four rays. I particularly mention this, as in some years what is supposed to be this fish visits the coasts in enormous shoals, like the herring of the British seas. Queen Charlotte Sound seems to be the place most frequently visited by these migratory shoals, which appear at the beginning of winter. The Picton herring, a dried fish, commonly known throughout the colony, is the aua, preserved by smoking. The larger-sized specimens that are occasionally got measure 11in. in length. The more common size is 7in. long, of a dark greenish tint, and more slender herring-like form. They vary in weight from ¼lb. to 1lb." In the Dunedin Harbour they are caught at times in immense numbers, and are very common in Auckland waters. They give good sport with the rod and line.

A fuller account is given of the sea-mullet by Mr. Johnston in his observations on the fishes of Tasmania. He says: "The sea-mullet is caught in the shallow bays of the upper waters of the estuaries, particularly those of the Derwent and Tamar, in very large quantities. In the latter river the young ascend regularly as far as Launceston about the months of November and December, when they are caught in large numbers by amateur fishermen with rod and line. It is supposed they follow the ordinary shoals of prawns, which are then found in myriads in the fresh water of the North Esk and in the Tamar. It is most probable that these young fish linger near the spawning beds in the lower salt-water flats until the appearance of the prawns, and then ascend into the upper fresh-water flats along with them.

"On a holiday hundreds of pleasure-seekers may be seen between Bridgewater and Hobart with rod and line, the chief attraction being mullet-fishing. Favourite points are frequented by enthusiastic anglers all the year round. It is no uncommon occurrence for a single angler at these places to land four to six dozen fish, averaging ¾lb. weight. Occasionally fish are caught reaching 1¾lb. Prior to the closing of the river Derwent, above Hobart, for the protection of the introduced salmonoids, the indiscrimate use of seine-nets almost destroyed the fish in these upper waters. From the evidence of old anglers it appears to be certain that, since the closing of the river, all fish have rapidly increased in numbers, size, and quality; the ruthless destruction of young fry on the nursery grounds has ceased; and it is affirmed with confidence that more fish are now caught with rod and line alone than could be got by sweeping the bays with the seine-net prior to its prohibition in this part of the river. It is also worthy of note that the class who principally fish in these upper waters are tradesmen, to whom the fish caught are a most welcome addition to the household fare. The fish measures on the average, 8in. to 12in. long, has two dorsal fins, the first considerably in advance of the second, composed of four spines."

Dr. Günther states, in respect of other members of this family, that, if attention were paid to their cultivation, great profits could be made by fry being transferred into suitable back-waters on the shore, in which they rapidly grow to a remarkable size. Local advantage might be taken of this suggestion.

MAOMAO (*Ditrema violacea*).

Length four times that of the head, or two and a-half times the height of the body; snout rather longer than the diameter of the eye; teeth, in viliform bands, on both jaws, the vomer, and palatine bones; upper profile convex; maxillary broad, produced to beyond the vertical from the anterior margin of the eye; margin of the præoperculum striated and finely denticulated; dorsal single, increasing in height as far as the second soft ray; anal higher than the dorsal, less than half the length of the head; pectorals shorter than the head, nearly twice as long as the ventrals, which are situated rather behind them; caudal forked.

Above, violet, passing into white below; vertical fins violet at the base; a spot of dark violet in the axils of the pectorals; iris, yellowish.

Captain Hutton adds: "This fish differs from the genus *Ditrema* in having lines on the palate, and a band instead of a single row on each jaw. It is said to be often mistaken for the warehou (*Neptomenus brama*), but the stronger dorsal spines and the shorter pectoral fins easily distinguish it."

It is a common fish, Dr. Hector says, near the East Cape and at the Bay of Islands for a few weeks in autumn, and is very much esteemed as food by the Natives. Captain Mair says the delicious little maomao may be caught at the Rurima Rocks in immense quantities. Mr. Gold-Smith says there is also an abundance to be got on Mayor Island, while the lighthouse-keeper at Moko Hinou tells Mr. Cheeseman the same story.

The Natives supply the following information. It is found, they say, in abundance in places about Tauranga Heads, all round the Bay of Plenty to Cape Colville. Average size, 8in. to 10in. in length. The tail of the fish, they say, is too large in the plate representing it in *The Transactions of the Institute*, vol. v. A deep-water fish, with small scales, silver belly, and as intensely local in habit as the trumpeter. It is only found in certain localities where there are sunken rocks, or deep water close to rocks near the surface. The places where they are found are marked by shore signs or bearings to enable the maomao fishers to find the fishing-ground again, or a slight misdirection will ensure a failure of the fishing expedition. The maomao only takes a small hook, preferring boiled shell-fish and cray-fish as bait, which it will only take about two months in the year. It has to be fished for with great care, as the line, if jerked, tears away from the fish from the tenderness of its mouth. Before the steel hook was in Maori hands, its capture was more difficult than now. It is found around both the Barriers, Tairua, and the Slippers.

MOKI (*Latris ciliaris*).

Length four times that of the head, or three times the height of the body; six simple pectoral rays; no vomerine teeth.

Above, plumbeous, with golden reflections; below, silvery white, with small brown dots; fins blackish.

Common, Captain Hutton adds, from Wellington southwards.

The moki is an abundant fish in the Wellington market, and, though occasionally seen at all seasons, is most common and in best condition during spring and early summer. It rarely takes bait, but is chiefly caught with the net. The quality of this fish is very varied, and much affected by the nature of the feeding-ground, though usually rich and well-flavoured. It is found on all rocky points of the New Zealand coast, the usual size being from 2lb. to 4lb., but it sometimes reaches 19lb. weight. The moki is admirably adapted for preserving, and when properly cured and smoked will keep for a much longer time than most other fish

when prepared in that manner. When in good condition the flesh of the moki is very rich, and well adapted for being cooked by roasting or baking, which latter is the favourite method of preparing this fish among the Natives in the South. There appears to be a difference in the size of the head and in the tumidity of the mouth in the specimens of the moki brought to market about midsummer, making two well-marked varieties that are supposed by some to be different sexes. Like the trumpeter, it would keep well and command a fair price if frozen for export.

Considerable quantities of this fish appear on the coasts of the Middle Island during the months of September and October, and also from the middle of January to the end of March, but the regularity of the supply is uncertain, according to the report of the Fisheries Commission. Mr. Inglis thinks they are driven off the coast at the latter part of the season by the dog-fish. They are abundant at Stewart Island, from whence the Dunedin fish market has been largely supplied. The Maoris resident on Cook Strait set nets and catch moki in abundance during the winter, Mr. Liardet stated in evidence. Mr. Thompson, of Dunedin, says: "This fish used to be seen very seldom in our market, but the superior knowledge of our fishermen of late has been rewarded by a plentiful supply."

NANNYGAI (*Beryx affinis*).

Height equal to length of head, and one-third total length; operculum with two spines; pectoral is one-fifth the total length; eye situated high, its diameter being one-fifth the length of the head, and exceeding that of the snout; snout with two nasal apertures close in front, the posterior being the larger; intermaxillaries carry five teeth on the sides, and a group of larger teeth on each side of a mesial notch, into which a projecting group of large teeth on the lower jaw fit.

Colour, crimson-pink; paler beneath.

It is called in Sydney nannygai, which is said by Mr. Hill to be derived from the aboriginal name of *mura ngin a gai*, whatever that may mean. Among the early colonists it used also to be called "mother nan a di," probably a corruption of the native name. The following remarks of the same author will be read with interest:—

"That which is taken on our coast visits some of the headlands once or twice during the year; is shaped like a squire or small schnapper, and does not attain a great size; its colour is

bright red, with iridescent streaks, and the colouring matter appears to be in the skin and epidermis, as they retain a portion even after being cooked.

"The nannygai has a very large eye, and is found in the vicinity of reefs, no doubt for protection, and is first fished for in deep water at the North Head of Sydney, in the month of October, with hook and line, using the ordinary schnapper bait. Great caution is necessary at times in approaching the ground, so that the boat may not be pulled over the rocks where they congregate, as these fish have been known to take alarm in such instances, and, in consequence, not to take a bait during the day; otherwise they bite freely, and many are taken. A month or two later a few are found off Middle Head, and some have been caught between Shark Island and Milk Beach. The North Head of Botany Bay also affords a rendezvous for these fishes, as also at intervals along the coast south.

"The beauty of this fish is to be seen only when first caught, and the flesh is much better when fried very fresh; in fact, most of the Australian fishes are tenfold better as food when just caught than when stale, although some keep tolerably well; but it cannot be expected that the nannygai, which puts in an appearance in the month of October, can keep many hours after removal from its element."

In the report of the Royal Commission of New South Wales the nannygai is thus described: "It is a deep-sea fish, caught only with hook and line, and rarely taken during the winter months. It seems generally to make its appearance soon after the commencement of the warm season, and, to judge by the number sometimes taken at one time, probably comes in considerable shoals, but we have not been able to determine whether it is a migratory fish in the true sense of the term—visiting these temperate seas in the summer and retiring in winter to warmer latitudes—or whether its appearance is merely, as is the case with very many fishes, a movement only from deep water to the neighbourhood of the land. The same uncertainty exists as to its spawning season. It is seldom seen full roed, and we have not found that the very young fish are ever seen in our harbours or on our coasts, so that it may be fairly inferred that, as a rule, it does not spawn in this vicinity. As an edible fish it ranks high; indeed, there are few better in the country. When slightly corned and smoked it is said to be a great delicacy. The fishermen never especially seek it, and it is only caught accidentally when fishing for schnapper."

Of the *Berycidæ*, Mr. Johnston says there are only two known representatives in the Tasmanian waters—viz., *Beryx affinis* and *Trachichthys Macleayi*. They are seen on rare occasions, and are consequently of little importance from a utilitarian point of view.

The larger number of the genera belonging to the family live at great depths. The genus *Beryx* is sometimes found at a depth of over 300 fathoms. Neither here nor in Tasmania does *Beryx affinis* appear to have a local name.

NGOIRO (*see* CONGER EEL).

PARORE, OR MANGROVE FISH.

UNCLASSIFIED.

A fish 18in. long, Dr. Hector says, with black bands on a dark ground; height equal to half the length; peritoneum black. Does not take bait, but frequents rocks among the mangroves at high water. Found in Ngunguru and Whangarei Harbours. It is particularly abundant, Mr. Seymour Thorne George says, at Kawau, where it is found in the nets frequently. Though a food fish, he does not give it a good character. The fishermen call it bream.

PARROT FISH (*Labrichthys psittacula*).

Two anterior canine teeth in each of the jaws.

Head, rose pink; throat, chin, and above the shoulders whitish; body sometimes uniform red, sometimes pale pinkish yellow, each scale tipped with deep pink; dorsal and anal yellowish, edged with pale purple, and with four or five rows of orange spots; caudal, yellowish, margined with grey, and red at the base; iris, pale rose; caudal, lunulate.

The report of the Royal Commission on the Fish and Fisheries of New South Wales says: "This family—*i.e.* the *Labridæ*—includes all the rock and reef fishes known as parrot fishes. A large number of species are found in our seas, but many of them are only occasional visitors from the warmer regions of the north, where the *Labridæ* abound." Very little is generally known about the species called in Dunedin the parrot-fish. Mr. Thompson found it, in 1877, in the Dunedin market fourteen days during the year. Captain Hutton stated that it was not uncommon in Cook Strait. It was caught by Dr. Hector in Dusky Sound, Preservation and Chalky Inlets.

PATIKI (*see* FLAT FISH).

PERCH (*Girella simplex*).

Length three and one-fifth times the height, and four times that of the head; orbital diameter equals half of snout, and one-fifth of height of head; mouth protrusal, with three imbricate rows of small teeth, with blunt curved tips and a crowded belt of setaceous teeth on the inside of both jaws.

Dorsal begins behind the insertion of the pectoral and over the ventral; first soft dorsal ray is over the vent; base of the anal is less than the soft dorsal, its length exceeding by one-half the height of the dorsal, which is one-fourth the height of the body; second anal spine less than the third, the first being merely a slender process from the second, and not distinct in its insertion; caudal, emarginate; lateral line arched; scales large, ciliate; colour (dried), olive brown.

Length 16in.

Dr. Hector continues his description by saying: "It is a handsome fish, in general form and size of scales resembling the kahawai (*Arripis salar*). This fish differs but little, except in its proportions, from *G.* (*Crinideus*) *simplex*. Rich, and is evidently closely allied to that species which frequents the east coast of Australia.

In Tasmania it is called "the sweep," ranking high as an edible fish. Mr. Johnston says that "neither the sweep nor the *Girella tricuspidata* (the black bream) are taken in much abundance towards the south of Tasmania, nor do they seem to ascend the estuaries so freely as the silver bream (*Chrysophrys Australis*). They are principally vegetable feeders—their rows of fine incisors, frequently tricuspidate, being well adapted for the purpose. They are most frequently taken together in the graball."

"In New South Wales," Mr. Ramsay says, "the herbivorous *Sparidæ*, the black-fish, under which name several species of *Girella* are known, give us a regular and palatable supply of good food."

The *Girella* belong to the same family as the schnapper.

PILCHARD, OR SARDINE (*Clupea sagax*).

Length rather less than four times that of the head, or five times the height of the body; lower jaw slightly prominent; maxillary extending nearly to the middle of the eye; ventrals below the posterior half of the base of the first dorsal; abdominal

serrature very indistinct; operculum with conspicuous radiating striæ descending towards the suboperculum; scales finely striated; a series of more or less distinct round blackish spots along the side.

"This is a true representative of the herring kind in these seas, and it visits the east coast of Otago every year in February and March, and when the schools migrate they extend as far as the eye can reach, followed by a multitude of gulls, mutton-birds, barracouda, and porpoises. So densely packed are they some years that by dipping a pitcher in the sea it would contain half fish, so that if large boats and suitable nets were employed thousands of tons could be caught. In the beginning of April they appear in Queen Charlotte Sound and are caught in large numbers, and converted by salting and smoking into the highly-esteemed Picton herring. Towards the end of April they appear on the coast of New South Wales, but nevertheless it is very probable that these herrings do not really migrate beyond retiring to the deep sea off-shore to deposit their spawn."

Mr. Fell, writing to Mr. Arthur, says: "The fish is found all round Queen Charlotte Sound, and also the adjoining Pelorus, but is only caught here (Picton). Generally it is believed that they do not extend outside, but my half-caste fisherman maintains that, if sought for properly, they would be found all round Blind Bay and in the Strait. They are not easy fish to find unless they are rushing to the surface, which is not often, and is a most peculiar sight. These herrings are in Queen Charlotte Sound during the whole year, but only come into the shallow bays during winter. At that time of the year they keep together in large shoals, but in summer time they keep more apart, and are sometimes caught then, though rather hard to find. No systematic fishing goes on during summer; the fish prefer colder water, and thus leave the shallow bays when spring sets in. They spawn during summer, are always full of roe about Christmas time, and then keep in small shoals. As to the probable numbers visiting the Sound, it is difficult to say, but four smoke-houses were kept going all last winter (1882). The hauls made average 1½ to 2 tons, but at times 10 tons have been landed."

They appear only occasionally in the Dunedin market. They are very abundant in the Auckland waters, Mr. Wilson states, and especially so at the Thames, which he considers one of the best fishing places in the Colony. They come in large shoals, he says, but no attempts have been made to catch them. In 1885 Mr. Donald Sutherland said, at the Wellington Institute: "There are large shoals of the pilchard at the head of Milford Sound. They are from 6in. to 10in. long. They finished spawning on the 2nd or 3rd of December. Tons of them are on the beach in Freshwater Basin.

They are not occasional but constant visitors, as, in the report of the Royal Commission on the Fisheries of New South Wales, we are told that they 'appear annually in immense shoals in the New South Wales waters about midwinter, passing in a northerly direction; and portions of the shoals sometimes enter the bays and harbours of the coast, but not certainly, as with most fishes, for the purpose of spawning, for the shoals at that time consist of small and immature fish.' The same fish are seen to pass south on the eastern coast of New Zealand about six or seven months afterwards, and then they are full-grown and full of roe."

As the New Zealand pilchard is regarded as only "a climatal variety" of the English pilchard, some details about the pilchard industry may not be out of place. The pilchard, moreover, is specifically the same fish as the sardine, from which it only differs, Mr. Houghton says, in some slight structural details, and thus, under the same inquiry, particulars concerning sardine preparation can also be gathered. Those who have given the matter attention have high hopes of the profits and dimensions the New Zealand pilchard and sardine trade may hereafter attain.

Pilchards are captured both by the seine and by the drift-net, the mode of using which will be found in another place. When the pilchard season arrives, men, bearing the title of "huers," are stationed on hills and cliffs to look out for the shoals, and to point out by signals to the fishermen the direction the fish are taking, after the manner of the Maori who had, in olden times, men similarly stationed to watch the coming of the shoals of the summer fish.

The greatest recorded catch by one seine at one shot was made at St. Ives in 1868. There, 5,600 hogsheads, or over 16 million pilchards, were saved out of one seine. This catch was worth between £11,000 and £12,000. Mr. Duff adds: "The seines did on one occasion in one day capture 10,000 hogsheads, or over 30 millions of pilchards, worth over the boat's side £2 per hogshead. I do not know the number of seines employed, but they could not possibly have exceeded twenty; but supposing they were twenty, then 20 acres, or at the highest figure 40 acres, of sea yielded £20,000 as its produce for one day, and each season consists of many days." So true is the remark of Professor Huxley that, in the waters frequented by the pilchard, the sea, taken acre for acre, is of greater pecuniary value than the land.

The Rev. Mr. Houghton gives the following: "The seiners have various difficulties to encounter when trying to enclose a shoal of pilchards, and it is more common to miss than to have a successful shoal. The tide has to be carefully considered. After

a shoal is fairly enclosed, and the seine moored, there are still many dangers and perils; for instance, the Rashleigh seine, near Tintagel, enclosed a fine shoal, but next day a ground sea came, which lifted the foot ropes, and enabled the fish to escape. Four days later the same seine enclosed a lot of fish, when a seal was found in the enclosure feasting, and when gorged broke through the seine without effort at his pleasure when and where he pleased. Only 30 hogsheads were saved out of some 600. Seines can only be shot on places where the ground is smooth, and the water shallow. Pilchard drift-nets, principally used on the coast of Cornwall, are about the size of those used for herrings, but with a slightly smaller mesh; in fact, shrunk herring nets are frequently used in the pilchard fishery when the meshes have become too small for their original purpose. Some of the nets in use have 40 or 42 meshes to the yard."

Of seines, Mr. Holdsworth writes: "For ordinary sea fishing seines may be divided into three classes—the circle-net or seine, the tuck-seine, and the ground-seine. The two first are especially used in the Cornish pilchard fishery. All these nets are used for surrounding or encircling the fish. They consist of a long train of netting, varying considerably in dimensions, but are always of greater depth at the middle or 'bunt' than at the ends, which are called the 'wings' or 'sleeves;' and they are shot in a circle if the net is to be worked entirely from a boat, or in a semi-circle if it is to be hauled on shore. The back or upper edge of the net is buoyed up with corks to keep it at the surface, a point of great importance, as the net is principally used for catching surface-swimming fishes, such as mackerel, herrings, and pilchards; and the foot is weighted with lead, to keep that part of it down, so that it may hang perpendicularly in the water. Two, or sometimes three nets are employed for enclosing a shoal of fish, or as much of it as can be managed at the time. The first or principal net, called the 'seine,' is about 200 fathoms long, and 10 fathoms at its greatest depth; to this another net of the same kind, called the 'stop-seine,' is fastened, and the two are shot together, each boat, with its own net, starting from the same place, rather on the outside of the shoal of fish, if it be not very large, but moving in different directions, although with the intention of ultimately reuniting. The 'huers' are stationed on the hills surrounding the bay, and signal to the men in the boats the direction the fish are taking, the appearance of the water over the fish plainly showing to these men what their course is. The seine is at first carried along outside the shoal, parallel with the shore, and then brought round towards it, thus cutting off as large a portion of the shoal as the net will compass, whilst the stop-net, which is fastened to the other, is shot at a right angle to the large

seine and towards the land, across the course of the fish. If one stop-net is not long enough for the purpose, a second is joined to it, and the ends of this and of the large seine are gradually hauled towards each other on the shore side till they meet. and the fish are entirely surrounded. The circle is then gradually contracted by taking out the stop-nets, till the whole catch is enclosed within the single large seine, the ends of which are at once fastened together. The whole concern is then slowly hauled towards the shore, into some quiet part, out of the run of the tide, if possible, till the foot of the net touches the bottom, and there it is securely moored with anchors on every side, and the upper edge with extra buoys. The advantage of having the bunt or middle of the seine deeper than the wings will be obvious when it is remembered that, if the foot of the net does not touch the ground all round, the fish may escape underneath; and, as the shore is always more or less shelving, a greater depth of netting is required for the deeper water. Such an enormous body of fish has been sometimes enclosed by one operation of the seine that it has taken a week to land them; and even with more moderate captures two or three days may be required. It is necessary therefore, in the first place, to have the net and enclosed fish securely moored. The next operation is 'tucking' the fish, or taking them out of their net prison. This is done with the tuck-seine, a net only 70 or 80 fathoms long, but very deep at the bunt or middle. It is shot inside the circle formed by the large seine, and as the two ends are hauled into the boat the bunt is gathered up so as to bring it under the fish and raise them to the surface, when they are dipped out with large baskets and put into the boats to be taken on shore. The circle made by the large seine is gradually contracted as the fish are taken out until the whole catch has been landed, and the nets are then taken on shore. If the shoal of fish is apparently a small one, then perhaps only a single net may be used, and the enclosed fish are at once 'tucked' into the boat."

Mr. Cornish says: "You must consider of this net (the seine) when shot as a round room in the water, without a floor or ceiling, and, if the shot is successful, it contains the pilchards. At the next low-water time a net, called a tuck-net, and which I will liken to a perforated pocket-handkerchief, is let down from large boats stationed at one side of the room of water, the tuck-net being inside the seine, and it is drawn up by means of ropes hauled in on board large boats stationed for the purpose at the other side, so as to scoop up the fish in the seine. As the ropes come home the boats close in upon the net, and then a very exciting, and on moonlight nights a very beautiful scene sets in. Millions of silvery little fish are spluttering and clattering

on the surface of the water in the tuck-net. Half-a-dozen men are in the midst of them up to their knees in fish, working for dear life."

Pilchard fishing is uncertain and "patchy." On one occasion, a writer says, ten boats with drift-nets went out in Torbay; no distance separated them. Eight took nothing, one got about 100, and one boat several thousands—in such compact bodies do they swim. Large bodies of pilchards may be attracted to the vicinity of the boats by throwing into the water a quantity of cod's roe—imported from Norway for this purpose. The French fishermen adopt this plan in their sardine fishing. Most pilchards are caught by the seine. When a shoal is sighted the seine boat moves in the direction indicated, and if it reaches the shoal in time it shoots its net.

In the Fisheries Exhibition, pilchards were found cured by all the methods in use. Salted in barrels for the foreign market, dressed in oil as sardines, in salt sauce as anchovies, or "marinated," by soaking them in strong salt water, and afterwards placing them in vinegar and oil. When the pilchards are cured in Cornwall for the Italian market, the method employed expresses from them, when "in bulk," large quantities of blood, which run from the curing houses down the streets in gutters to the sea; hence the old Cornish toast "Long life to the Pope, and may our streets run with blood." The chief Italian markets for pilchards are Genoa, Leghorn, Naples, Civita Vecchia, and the Adriatic.

Mr. Howard Fox, in *Land and Water*, thus describes their manufacture into *Fumados* or *fermadi*: "Women arrange them, first putting a layer of salt, then a layer of pilchards, and so on until 'the bulk' is from 3ft. to 5ft. high; the outside row of fish is laid with the heads out and slightly turned up, and the inner rows at right angles to them. French and Spanish salt, being a larger grain, is much preferred to English for the purpose. The fish remain in the bulk for thirty days, during which time brine and oil drain from them into pits specially arranged for the purpose. They are then taken out, sifted free from the dry salt, washed in a seine, and placed in regular order in casks of 50 gallons, called hogsheads, the tails of the fish pointing to the centre and the heads out."

Pressure is next applied by means of levers, to which weights are hung, and the casks are refilled and pressed three times during the space of nine days; the weight of the hogshead should then be 476lb., and the fish in each cask will vary from 2,500 to 3,000, according to size; all under 8in. being usually excluded, and packed

separately in other casks to be sold as small fish chiefly for home consumption. The entire cost for curing ranges from 15s. to 22s. per hogshead. While the pressure is being applied the oil escapes from crevices left for the purpose in the bottom of the barrels. From 2 to 4 gallons of oil are obtained from each hogshead of summer fish. Pilchard oil is sold in Bristol, and converted into foreign cod oil by forcing steam through it, and other processes, the price being governed by that of cod oil, and varying from £30 to £40 per ton. It is excellent for mixing paints.

A large trade in cured pilchards is carried on between Cornwall and Spain, the idea having originated at Mevagissey. In 1876, a fish curer (Mr. Dunn) found there was a demand in the Mediterranean fish markets for bright salted pilchards. He first thought the matter out, and then proceeded and cured several tons by throwing them, with salt, into barrels, and allowing the brine to rise over them. After keeping them steeped for some weeks they were washed, packed, and pressed into clean barrels, just as was formerly done by the old-fashioned *Fumados*. On their being put on the market it was at once seen they were the article wanted, for these fish, instead of having the dirty yellow hue of the *fumade*, had the desired bright and clean silvery colour; hence they have been in demand ever since. The fish curer in question took out no patent rights, but allowed all to use his discovery, so much so that for some seasons past not less than 1,000 hogsheads of fish yearly have been shipped for the Mediterranean from Mevagissey alone. The barrels first used have been superseded by large steeping vats, one of which will hold over 500,000 fish. Since the business in question has been progressing, it has been discovered that the Spaniards cure sardines much after the same manner.

Pilchards have been known to ascend into brackish water when under the influence of fear. Thus, a large number were taken in the Dart, at Totnes Weir, having been chased there by porpoises; and, in July, 1880, when it was nearly low water, one was seen coming down the same river by persons standing on Totnes Bridge, which is 12 miles from the sea, pursued by an otter. The pilchard leaped on the bank, and was secured. The fishermen say that they have seen pilchards in multitudes quiescent at the bottom of the sea, as if examining with their mouths the sand and small stones in the shallow water, and probably hunting for food, the largest fish, similar to the mackerel, being furthest out to sea.

It has been said that the pilchards in some seasons swim low, due to diminished temperature in the upper waters, or from some other cause, and consequently escape beneath the nets.

The following statement of the total number of pilchards exported, with price per hogshead, is from Messrs. Fox and Company's Pilchard Circular for 1882; it gives a summary since 1870 to 1882 :—

Year.	Total Hogsheads.	Price per Hogshead, to Curers.
1870	6,048½	60s. to 90s.
1871	45,683½	20s. to 68s. 6d.
1872	1,138½	Previous season's fish.
,, ...	18,406	38s. to 85s.
1873	31,019	25s. to 51s.
1874	819	Previous season's fish.
,, ...	7,543½	60s. to 89s.
1875	7,337½	52s. to 95s.
1876	9,903	52s. to 100s.
1877	9,477	40s. to 80s.
1878	10,309	30s. to 60s.
1879	11,937¾	41s. to 68s.
1880	11,843	55s. to 80s.
1881	13,963	42s. to 75s.

Having written so fully of pilchards, of sardines there is not so much to say. Sardines are prepared at Mevagissey as follows: Immediately the fish are landed they are taken to the factory and cleaned; then the washers arrange them in light trays, head downwards, to drain and dry. They are next boiled, then packed in tin boxes, which are filled up with the best olive oil, and subsequently soldered down. These tins are again boiled and the fish are ready for market. There were two open barrels of fish exhibited, one at each end of the westernmost case in the Spanish Court of the Fisheries Exhibition; and one was labelled "pressed sardines," and the other "salted sardines," but they were both pilchards from Cornwall, only more cleanly cured than usual. "Sardines" to the value of 825,000 dollars were packed in Maine, in 1880, the fish being young herrings. The Eastport (Maine) trade gave employment at that date to over 1,500 fishermen and factory hands, in addition to 376 fishermen belonging to New Brunswick. The capital employed in Eastport alone on the sardine industry was over 480,000 dollars. In 1881, Japan produced about 194,657,489 kin (the kin being equal to English 1·32377lb.). The sardine fishery is one of the most important in Spain, the quantity caught being over 100,000 tons a year. On the Spanish north coast, where the greatest trade and exportation take place, the export of sardines, exclusive of those tinned,

average annually from 61 to 62 millions of kilogrammes, of the value of £80,000 to £120,000 sterling (a kilogramme is 2lbs. 3ozs. 5drs.). Lieut.-Col. Francisco Garcia Sola estimates the value of the tinned fish in Spain to equal that of the dried and salted. In Greece the sardine fishery takes place in Corinth, Chalcis, and Oræoi. It only lasts during the summer months, but it affords employment while it does to some 1,500 persons. The fish are caught by a fine seine-net, and always salted. These towns produce from a minimum to a maximum of 5,000 barrels annually. The salting is conducted in the simplest way. The fish are gutted, washed, and placed in the barrels, every layer of fish being alternated with a layer of salt.

In France, on landing, the sardines are taken from the boats to the factories in hampers. Women are employed to cut off the heads, to open and cleanse the fish, and place them one by one on stone or marble slabs, previously strewed with salt. While this preliminary drying takes place the fires are lighted, and the purest olive oil is put into large cauldrons. When the oil is in a state of ebullition the sardines are laid in layers in iron-wire baskets, provided with handles. These baskets are plunged into boiling oil, and then placed on shelves, covered with sheet zinc, to drain, the oil being caught for future use. The fish, when moderately dry, are taken to a drying-house exposed to the sea-breeze, and, having remained there a sufficient time, are sorted, put into boxes, the small being used for the manufacture of anchovy paste.

In Spain the most important gear employed in sardine fishing in the "cerco real" (royal circle). The fishermen, by means of twenty or thirty boats carrying this net, make a great circle and surround a large space of water, joining different parts of it, putting both ends together, and afterwards drag the whole net towards the shore, forming at last a smaller enclosure. Here the sardines are kept until the preserving factories are able to make use of them, and thus is obviated the necessity of throwing away much useful fish, or using it for manure, as happened in former times with the surplus of the daily consumption. These nets are, it is stated, frequently 1,000 fathoms, or more than a mile long; 18 fathoms, or 108ft. deep; and employ, on some occasions, directly or indirectly, 150 men. They take, it is added, 10 to 14 hours to set. The fish are tempted to rush into the nets by cod roe, scattered on either side of the wall of netting. The nets used in Galicia for sardine catching alone are said to be worth £220,000.

POHUIAKAROA (*see* Sea Perch).

PORAE (*Chilodactylus Douglasii*).

Head three and a-half times the length; height two and a-half times; body compressed, elevated; snout produced; profile above eyes abrupt; snout three and a-half times the orbital diameter; fifth, sixth, and lowest pectoral rays thickened and produced to opposite the ninth anal spine, fourth lowest extends to the vent; anterior insertion of pectoral below the sixth dorsal spine, which is the highest of the series; soft dorsal commences over the vent, is uniform, but not equal to the spinous in height, and extends further back on the tail than the anal; ventrals below the tenth dorsal spine.

Thoracic region keeled, jugular with cross folds; lips tumid; teeth in a single series on intermaxillaries above, and on lower maxillaries small, trenchant, and deeply embedded in a fleshy gum; cheek scaled; horizontal branch of operculum smooth; head and shoulder scales minute, body scales two-thirds diameter of orbit, cycloid; lateral line curved; stomach with a deep fundus and pyloric branch equal in length to æsophagus, four short cæca; intestine folded three times with a distinct spleen; a distinct rectal division of the colon with strong muscular walls; remainder of the intestine membraneous; abdominal cavity lined with black pigment; swim-bladder large and divided into lobes; food, small crustacea.

Colour, grey or green on back and head; dorsal, blue-grey with green spots; cheeks silvery; gold and green patch on humerus and behind the gills; back and sides of body green; belly, silvery; fins, steel blue.

Such is the description given of a fish by Dr. Hector, which, he says, is not common, but highly esteemed as food. It is very local in its habitat, and is caught alone with tarakihi in 10 to 15 fathoms of water. Only two, however, he adds, were caught among 100 tarakihi. The length of the specimen from which the description was made was 2ft.; and it is found at Ngunguru Bay (north of Whangarei), the Bay of Islands, and Auckland in October. It was named after the late Sir Robert Douglas.

RED COD (*see* COD).

RED GURNARD (*see* GURNARD).

RED MULLET (*Upeneoides Vlamingii.*)

The height of the body equals the length of the head, and is three and two-thirds in the total; the barbels reach to the angle of the præoperculum; the vomerine teeth are divided into two lateral groups.

Red, each scale with a violet speck, forming together longitudinal series; snout and cheeks with oblique violet streaks; the second dorsal and anal fins with longitudinal series of violet specks.

Dr. Hector says: "The red mullet represents in these seas a fish that is highly esteemed in Europe, and which was prized by the Romans for their banquets above all other kinds. Our red mullet was first caught by Captain Cook in Queen Charlotte Sound, and the second specimen was not caught for a hundred years afterwards, off The Brothers. It is probably not uncommon, and, if its habits were better understood, could be obtained in quantity for the market."

Mr. Wilson says the red mullet are frequently found in the Kaipara. They are occasionally caught at the Great Barrier. The Rev. Mr. Tenison Woods writes: "We have in Port Jackson *Upeneoides Vlamingii*, a red fish with a violet spot on each scale, and violet oblique streaks on the cheeks; and *Upeneus porosus*, a red fish with two silvery streaks between the eye and the mouth, parts above the lateral line darker, and the spinous dorsal blackish. The difference between the two genera is that *Upeneoides* has teeth on both jaws, on the corner and palatine bones; *Upeneus* has teeth on both jaws in a single series and more on the palate."

"The red or brilliant pink hue which the red mullet, sold in the English market, displays, is," Mr. Kent says, "partially produced by the practice of removing its scales with the thumb nail, or other means, immediately after capture, and while still alive, causing the more brilliant display of the red pigment contained in the colour cells distributed over the surface of the body." It must be borne in mind that the English red mullet is not the same species as ours, though closely allied to it. It is said in justification of the practice, that, were the scales not removed at the time of capture, and the fish to dry while in transit to the market, they (the scales) would become very adherent, and it would be difficult to remove them without tearing the skin. A similar brilliant display is exhibited by the fish when dying under ordinary conditions, and it was one of the favourite pastimes of the Romans to hold banquets for the purpose

of watching the changing colours of the fish, as Jardine writes, "While the bright red colour of health passed through various shades of purple, violet, blue, and white, as life gradually ebbed, and convulsions put an end to the admired spectacle. They put these devoted fish into crystal vessels, filled with water, over a slow fire, upon their tables, and complacently regarded the lingering sufferings of their victims, as the increasing heat gradually prepared them for their pampered appetites." Shrimps, worms, and other small living marine animals form the chief staple of the food of the red mullet, and the ancient belief that it was a foul feeder is not borne out by modern inquiry.

The red mullet is captured in ground-seines, trammels, beam-trawls, and mullet-nets. Occasionally they take a bait, but rarely. The reason assigned for their being taken in drift nets is that, when changing their locality, they swim very near the surface, even should the water be deep. Those taken in a trammel are of more value than such as are captured with the beam-trawl, because, being less bruised, they keep longer. They are only found on the Cornish and Devonshire coasts in England in numbers; and but few instances are authenticated of their capture in Irish or Scotch waters. Thus they may be abundant in one part of our coast and almost unknown in others. Mr. Dunn says the ova are shed only a little at a time, and that the process may extend for days or weeks.

The liver is considered the most savoury portion of the fish, and, in olden times, its head was regarded as next in delicacy.

"On the British coasts," Mr. Kent states, "the red mullet rarely exceeds a weight of from 1lb. to 2lb., with a length of 12in. to 14in. Occasionally, however, they have been taken over 3lb. in weight, and in the Mediterranean they grow to larger dimensions." Mr. Houghton considers their usual size from 8in. to 14in., but he records the capture of one at Mevagissey of 17in. Six in Mr. Williams' fish shop, in Auckland, in May last, were from 12in. to 14in. in length, averaging about 2lb. each. They came from the Barrier, and were the greatest number Mr. Williams has had at one time.

"In normal seasons," Mr. Day writes, "these fish are found along the southern coast in Cornwall at about 20 miles out to sea in March, and from 9 miles to 10 miles in May, when they come in with the mackerel, but are said to be of a roving disposition. They are off the coast all the year round." Mr. Houghton says they swim in shoals, sometimes near the surface, but usually frequent the deeper parts, and take their food from the ground. In the summer they come quite close to the shore and rocks, and

a few are caught in such localities; but the trawlers have generally to go several miles from the shore to effect their capture. In winter they retire to deep water and are not caught in such numbers as during the summer.

As to the value, alluded to by Dr. Hector, in which they were held by the Romans, there are many records. The epicure Asinius Celer is stated to have paid a sum of not less than £65 of our currency for a single fish. Martial has an epigram on one Callidoris, who sold a valuable slave, that, with the price of the sale, he might purchase a red mullet to grace a feast he intended giving. The epigram has in this manner been translated:

> Thy servant thou for a great sum did'st sell,
> That but once, Callidore, thou might'st fare well,
> Nor far'dst thou well: a mullet of four pound
> Was the head dish which the whole table crown'd.
> May we not, wretch, exclaim against thy feast?
> Say 'twas a man, not fish, that thou did'st eat.

Mr. Mitchell writes: "A mullet of 2lb., each pound 12oz., was expected to bring its weight in silver. This value was often exceeded when the fish had grown scarce in their own waters, and had to be sought on the coasts of Corsica and the south of Sicily. Juvenal speaks of a single surmullet as having obtained the price of almost £50. The more sober Suetonius tells us that on one occasion three of these mullets were sold for 30,000 sesterces—at least £70 for each fish."

RED SCHNAPPER (*Anthias Richardsoni*).

Length about three and three-quarters the length of the head, or three times the height of the body; length of the head rather more than three and a-half times the diameter of the eye; lower jaw longer; operculum with two flat spines; præoperculum serrated—feebly on the posterior margin, acutely on the lower; teeth on the vomer, palatine bones, and tongue; cleft of the mouth very oblique; maxillary much expanded and truncated at the end, extending to the vertical from the middle of the eye; sixth dorsal spine the longest, less than half the length of the head; second anal spine very strong; scales finely serrated; caudal forked.

Uniform rose pink, passing into pale grey on the body.

The red schnapper belongs to the same family as the hapuku and kahawai, the *Percidæ*. It was described as a new species by Captain Hutton, and is not, wrote Dr. Hector, unfrequently

caught in the Sounds on the west coast of Otago. It is generally called the red schnapper by seamen who are acquainted with the fish of the coast, the colour being a uniform bright red, with a few dark streaks on the fins and a black spot on the side. The length of the figure lithographed was 12in., he said, but larger specimens were obtained by him in Anita Bay, Milford Sound. A specimen from which Captain Hutton corrected his first description was 17½in. They were subsequently found in Dusky Sound. White Island is one of their most favourite resorts. Macleay places the same species in Tasmania, but it is not mentioned either in the catalogue or the description of the fishes of Tasmania by Mr. Johnston. Günther says there are about twenty species of the genus in the tropical and temperate seas, but they are mostly small in size and agreeably coloured, pink and yellow being the predominating colours. Aristotle said that fishers of sponges called one species sacred, because no voracious fishes came to the places which it frequented, and the diver might descend with safety.

ROCK COD (*see* COD).

SAND EEL (*Gonorhynchus Greyi*).

Length five and one-seventh times that of the head, or ten and four-fifths the height of the body.

Back, greyish brown, with minute black dots; a dark grey patch over each eye; scales on the sides, pale purplish blue, edged with brown, and minutely dotted with black; belly, reddish white; iris, purplish brown.

This curiously-formed fish is remarkable for its eel-like shape and projecting snout, from beneath which its mouth protrudes like a sucker. It is caught with the net on shallow banks, and is brought to market in summer with the gar-fish. The flesh of the sand-eel is firm, of a white colour, and delicate in flavour. It is in no way related to the eel family. It is never plentiful, and was found in the Dunedin fish market on an average of only forty days in the year. [illegible] not uncommon in Wellington Ha[illegible] [illegible] found at the Cape of Good [illegible] or at the [illegible] Island, and other places. It is [illegible] [illegible] ptured.

Dr. Hector adds to some of the foregoing details the following: "Another fish caught in considerable numbers in Wellington Harbour, *Hemerocœtes acanthorhynchus*, chiefly with the hook from the jetty, is often also called the sand-eel, but is inferior to the last-mentioned fish both in flavour and size. Both fishes are coloured with variegated, purple, and blue markings, and are remarkably beautiful when alive."

SCAD (*see* HORSE MACKEREL).

SCHNAPPER (*Pagrus unicolor*).

Length about three and three-quarters the length of the head, and two and three-quarters the height of the body; diameter of the eye equal to the interorbital space; fourth dorsal spine the longest, and goes two and a-half times in the length of the head.

Reddish, more or less tinted with brown, and with numerous blue spots on the sides; below, silvery grey; upper part of caudal reddish, lower part pale grey; iris, pale brown.

This fish sometimes attains a total length of 31in.

Dr. Hector says: "There are few fishes better known in the northern parts of the Colony than the schnapper. This name, by which it is best known, is adopted from Australia, its Maori name, tamure, being seldom used by Europeans. It represents in these seas the braize of the European markets, and is remarkable for its singularly abrupt profile and the brilliant metallic lustre of its scales. The schnapper is not frequently reported to occur south of the Kaikoura Peninsula. A few have been caught off Moeraki, but the fish which usually goes by that name in the Dunedin market is the tarakihi. The schnapper frequents shallow water, and is generally caught with the net in Wellington Harbour, but the Natives may often be seen catching them with a hook and line in the surf on exposed sandy beaches when the wind is off shore. In clear shallow bays troops of this fish may be observed rooting up shell-fish [illegible] buried in the sandy bottom, and crushing them with their [illegible] armed jaws. [illegible] is the weight of an average-sized [illegible] the Wellin[illegible]rket, but they are [illegible] obtai[illegible] that siz[illegible] handsome fish [illegible] baked, [illegible] being the pre-[illegible] eaten [illegible] cold."

An idea of the abundance of the schnapper in northern waters can be gathered from the evidence of Mr. McLeod before the Auckland Fisheries Committee in 1870. In reply to the question, Has fish-curing been tried on a large scale in New Zealand? he said: "I am not aware of its having been tried on a large scale, but in January last I took 1,900 schnapper in one haul in a seine-net, and in curing this large quantity there was not a single loss, although the month of January is the least adapted of all seasons for fish curing." Some few years since the Natives at Maketu were said to have had a haul of 20 tons.

The following details are taken from the report of the Royal Commission on Fish and Fisheries of New South Wales: "It is a deep-water fish, found generally on or near rocky points or reefs running miles out from the coast. Its food is chiefly the mollusca living on the rocks, though the readiness with which it snaps up bait of the most varied description indicates tastes of an omnivorous character. Like all or most fishes it has its periods of migration and accumulation in shoals, a movement well expressed by the term schooling. The time of the appearance of the 'school schnapper' is the early part of summer; it is then believed to be three years old, the previous stages of its existence being well known under the names of 'red bream' at the age of one year, and of 'squire' at two. At a still greater age the schnapper seems to cease to school, and becomes known as the 'native' and 'rock native,' a solitary and sometimes an enormously large fish. At the first appearance of the school-fish in early summer the roes are small, but the full size is attained in or about January, about which time no doubt the spawn is deposited. The actual mode of deposition of the spawn has never been observed, and the same may be said of the date of the appearance of the young fry; but there can be little doubt that the deposition takes place in moderately deep water near the land, and that the young are hatched before the winter season. The young fish, in the shape of red-bream, are abundant in the harbours and inlets, but never in shallow water, and are seldom taken in large quantities in the seine; they take the hook, however, freely, and the capture of them is a favourite pastime of the Sydney people."

Count Castelnau remarks that the female has always a rather oval profile, and the young male has the same, but in the latter sex age brings on the development of a curious crust on the nape of the head, and a protuberance, which, in very old individuals, takes the appearance of an enormous nose, and gives to some of these individuals a most remarkable resemblance to the human face. Some old specimens assume a beautiful red colour. The young are covered with white and sometimes blue spots.

"The range of this species is very wide. Any isolated reef or submerged rock surrounded by deep water," Mr. Woods says, "may be considered its favourite haunt." "The largest of the genus," Mr. Hill writes, "are caught off points at nightfall, at certain times of tide—young flood at some, ebb at others. A fine old fish, monarch of his ground, cunning and fastidious to a degree, a regular epicure—he must be tempted with choice morsels before the well-chosen bit which conceals the hook will engage his attention. And you must bear in mind, at the same time, he is only a 'oncer'—that if he once fairly took the bait and you pricked or missed him in the strike, it was good-bye for that time; once fairly hook him with strong tackle your work and anxiety for the time it lasts will be something intense. The tugging, jerking motion of the schnapper is unmistakeable, and when he gets his shoulder to the line he goes off with a rapidity that makes the cord whistle again, either through your fingers, or over the boat's gunwale; a steady and continuous strain, no stray line, together with some skill enables you to safely land him, at which time you can realise that your patience, toil, and anxiety are rewarded with a fish from 20lb. to 25lb. weight, fit to embellish a noble banquet. The bait for these fish are star-fish, squid, mackerel, yellow-tail, mullet, and other fishes; the whole of these at particular times will be readily taken, but when the schnapper appears dainty, mackerel and squid may tempt him when all others fail. Cook it whichever way you please—by the primitive and impromptu method, frequently adopted by fishermen, of roasting it before a fire elevated an inch or so from the ground by the aid of a couple of forked sticks, which answer the purpose also of turning the fish by lifting them from the ground and reversing their position. No preparation is necessary in the first instance, save to take out the inside and wash the part clean. When sufficiently cooked the scales will come off from either side in one flake, leaving a firm, beautifully white, and tempting dish."

For the table, boiled and served with egg sauce; in fillets, or as a curry, any way, the fish is excellent.

Schnapper heads, so constantly wasted, simmered in water, flavoured with pepper and salt, and a little lemon, make most excellent soup, eaten with bread and butter—called by some, water souchie. For stock for fish soup nothing better, it is said, can be obtained.

Captain Robinson gave some interesting evidence before the Committee of the Provincial Council of Auckland, some fourteen or fifteen years since. "On one occasion," he said, "on a voyage to the Mauritius, I took a quantity of schnapper, cured as cod,

for the consumption of myself and crew, and we preferred it to cod-fish, inasmuch as it kept remarkably well, and was firm when cooked, while the cod-fish became much broken before it could be used." He added, further: "I consider schnapper equal to cod, and far superior to ling."

Mr. Wilson says it resembles lobster in taste when canned. It dries and salts well. Every one in Auckland knows what it is like when smoked and dried.

SEA BREAM (*see* WAREHOU).

SEA MULLET (*see* MAKAWHITI).

SEA PERCH (*Sebastes percoides*).

Total length three and a-quarter times that of the head, or three and a-half times the height of the body; diameter of the eye rather more than the length of the snout, and less than one-third of the head; interorbital space rather less than half the diameter of the eye; vertex with prominent spines; a flat expanded and crenulated tentacle on the interior side of the anterior nostril; third and fourth dorsal spines the longest, rather less than half the length of the head.

Head and fore part of the back, olivaceous brown; hinder part of the back and sides, reddish orange; belly, yellowish; five transverse bands of olivaceous brown on the sides and back, which are partly produced on to the dorsal; fins, pale yellowish, marbled with olivaceous brown; inside of the mouth, violet; iris, hazel.

"The pohuiakaroa," Dr. Hector says, "deserves mention, as it represents in these seas the genus to which the Norway haddock belongs. It is one of the most frequent and troublesome fish, caught in a moderate depth of water round the coast, and especially in rocky harbours, being almost worthless as food, and armed with so many sharp spines that it is a difficult task to detach it rom the hook. It is the proper sea-perch of these waters."

In Tasmania it is called the rock-gurnet, and represented as frequenting the lower portions of large estuaries, or on fishing banks, from 3 to 8 fathoms deep, in the neighbourhood of

still deeper water. "The Tasmanians hold it in great esteem for the table," Mr. Johnston says; and that it is caught abundantly on the northern coast. They are also found on the trumpeter ground." In Victoria it is called the red-gurnet perch; in New South Wales the gurnard-perch. The Tasmanian fishermen give it no better character as a food fish than Dr. Hector.

It will be seen that a difference of opinion exists as to its quality.

SILVER EEL (*Congromuræna habentata*).

Upper jaw much projecting beyond the lower; dorsal commencing immediately behind the base of the pectoral; tail longer than the body in the proportion of three to two.

Above, pale greyish; below, silvery white; vertical fins narrowly margined with black; iris, white.

In Macleay's *Descriptive Catalogue of Australian Fishes* there is said: "Melbourne, once seen. *Bondi* (one specimen cast on beach)."

In the Tasmanian catalogue it is described as rare. Mr. Barnett, lessee of the fish market, said in evidence: "I have seen a few brought to market in winter, but do not know where they are caught."

The silver-eel of New South Wales is of a different genus.

SKATE (*Raja nasuta*).

MALE.—Back nearly smooth, with a few scattered asperities; a patch of sharp hooked spines near the centre, and another at the anterior basal corner of the pectorals; anterior edge of the pectorals with small hooked spines; tail with a single row of blunt ribbed spines, with smaller ones between them; snout produced, acute; anterior lateral profile deeply emarginate; interorbital space concave, about one-third of the length of the snout; mouth crescent-shaped; teeth long, curved, and pointed, except the posterior ones, which are blunt; dorsals nearly equal, distance between them equal to the base of the first.

FEMALE.—Back rough, belly smooth; five to six spines over each eye, one to three on the back over the shoulders; no hooked spines on the pectorals, except some small ones on the anterior edge; tail with three rows of spines, one on the top and one on each side, those on the top continuing up the back as far as the end of the ventrals; teeth smaller than in the male.

According to Mr. Thompson's observations, the spotty is also known in Dunedin as the butter-fish, as, when writing in 1877, he said: "The spotty, or butter-fish of our local fishermen, has been very plentiful this year, and has been brought to town in large numbers at times; was in the market 128 days, as against thirty-four days for last year." The next year he tells us "that it was a regular seine fish, and got along with the flounders," etc.; adding in the most tantalizing manner possible, "There are two sorts of spotty—a big and a little." And then, after saying the fishermen called them kelp-fish, writes: "Spotties in market 154 days." They were found by Dr. Hector in the West Coast Sounds; and Mr. Cheeseman has noticed them as far north as Auckland. They are found in Tasmania, and recognized as a food fish, but are not held in much favour. It is there called the parrot-fish. It belongs to the same family as the parrot-fish of New Zealand, the *Labridæ*.

SPRAT (*Clupea sprattus*).

Head four and one-third times in the length, and less than the height; first ray of dorsal equidistant from centre of eye and root of caudal; ventrals beneath the anterior base of dorsal; eleven distinct abdominal serrations behind ventrals; mouth small, with lower jaw prominent. Maxillary expanded, extends to beneath anterior margin of orbit; opercles smooth (larger specimen with reticulate veins on præoperculum, but not striate), posterior margin with a blunt notch; tongue with an oval patch of teeth, and teeth also on palate; gillrakers fine, close set, and shorter than diameter of eye; scales large, regular, smooth.

Colour (from smaller specimens) silvery, darkish on back, with patches of minute spots; the sides in certain lights also show eleven bright stripes; pigment spots scattered over the snout, and in two regular lines on lower jaw.

Mr. Arthur writes, in the *Transactions of the New Zealand Institute*, vol. xv., p. 204, sec. 9: "This beautiful little silvery fish is mentioned by Dr. Hector as having been found in Foveaux Strait and near Wellington. A fishmonger in Dunedin remembers it being in the market about eight years ago (1874). I cannot find that this herring has been again seen on our coasts till May of this year, when it appeared in large numbers for a short time at Oamaru, close in-shore, about a fortnight altogether. The shoals did not visit Moeraki Bay or Dunedin Harbour. One circumstance may fairly be inferred from the minuteness and buoyancy of the ova, which is that in whatever depth of water

the spawning, may take place the hatching will occur on the surface of the sea in all probability. I have made a rough calculation from the size of the roe lobes, and find that one of these fish will contain over 20,000,000 ova."

Mr. Stoddart, writing to Mr. Arthur, says: "For years prior to 1875, when I was living near Moeraki, the sprat visited the reefs regularly from March till May in incredible numbers, which were easily seen by us while fishing there, as they came close under our boat. They always disappeared on the approach of cold weather. The red cod (*Lotella Bacchus*) which we caught on the reef were often found to be stuffed full of sprats—indeed, they were sticking out of their mouths. The fish reef lies about 3 miles off-shore."

In a subsequent letter from the same gentleman, he adds: "I have made inquiries about the sprats. Captain Liddle (who has been fishing at Moeraki for the last fifteen years) says they are there every year in any quantities about the reefs a mile from the shore. They begin to appear about January, but are most plentiful in March and April. On two occasions during that period they came in-shore into Moeraki Bay in dense masses, as they did also at Oamaru and Timaru. He could give me no information which way the shoal travels, as they seem to be all over the sea; and accounts for their going close in-shore, sometimes in dense masses, to other fish pursuing them.

"Mr. Leggatt, who used to have the landing service at Port Moeraki, and is now in Christchurch, also knows the fish very well, and remembers his boys getting buckets full, left among the holes in the rocks by the ebb tide, some four or five years ago. Captain Liddle says that with a hoop-net, which he sinks a few feet at the stern of the boat, and then throwing over some food he can catch any quantity any year. There were plenty at Moeraki at the same time (May, 1882) these shoals were in Oamaru Bay, but they did not come close in."

Mr. Cosgrove writes: "It makes its appearance on the east coast of the Otago Peninsula in the month of November, and remains off the coast of the South Island throughout the season, which is, so far as I can gather from searching inquiries and from personal observation, from November to the end of March. When first seen the shoal is usually travelling southward. Still, this is not invariably the case, as I have on one or two occasions seen it head towards the north. The direction in which the shoal is moving can at any time be ascertained by watching the movements of the mutton-birds (*Puffinus tristis*). These birds follow the shoals in vast numbers—indeed, I might say, in myriads. So great are their numbers that I have seen a portion of the surface of the water, several square acres in extent, literally black with them.

"The shoals pass and repass the coast between Ocean Beach and Sandfly Bay several times during the season, at a distance of from a-quarter of a mile to two miles from the shore, according to the state of the weather. Should the sea be very calm, with a gentle breeze from the land, they are almost sure to come in-shore.

"For many years in succession they came in at Sandfly Bay, a beautiful spot at the foot of Mr. W. Robertson's property, but they have only twice visited that harbour during the last five years; when, however, the sprats do come in, either at this place or any other place along the coast, they come so close that all the pools around are actually packed with them, and when the tide ebbs, the silvery little creatures may be seen turning over on their backs in thousands, dying for want of oxygen.

"Mr. W. Robertson informs me that the shoals have passed Sandfly Bay every year since he settled there in 1860, and that in 1881 a shoal came in for a few minutes, but went out again, and passed on towards the south.

"The shoals are sometimes followed by great numbers of red-cod, barracouda, groper, and dog-fish, and these again are followed by seals. When such is the case, the scene from the shore baffles description. On the outside of the shoal are terns, gulls, and mutton-birds, fighting and screaming over their prey; while beneath are the large fish already mentioned driving the sprats towards the surface; and, added to the noise of birds and fish, you hear the sudden splash and short bark of some three or four seals. So pressed have I seen a shoal, that several square yards of the fish were raised quite out of the water by the efforts of the sprats at the bottom to get out of the way of their enemies' attacks from below. On one of these occasions I caught six large dog-fish by means of a large hook lashed to a long rod. As these fish lay struggling on the rocks, sprats came sliding and even jumping out of their mouths in great numbers.

"As an article of food the sprats are really excellent. When fried in olive oil they are deemed a luxury by the most epicurean. As to how they could be caught for market when off-shore, I dare not venture an opinion; but when they are in-shore I can with confidence affirm that they could be caught in great quantities with hand-nets alone. Indeed, so numerous are they at these times that a man standing on the rocks could lift them out of the shoal with a shovel."

Sprats are called kupai by the Natives at the Thames, and are found in great abundance—in tons, Mr. Masefield says—in the early months of the year in the Kaipara waters.

The sprat is deservedly esteemed as food, being nutritious and cheap. In some parts of Scotland they are thus preserved: Selected fish are washed in salt and water, then threaded on wire skewers and suspended for two hours in a pickling vat, so that no two fishes touch one another. On being removed they are hung up in a current of air until the next day, when they are smoked like bloaters until they assume a yellow colour. They will keep four or five days, and additional pickling and smoking will enable them to keep longer.

Anchovy paste from sprats may be made as follows: Sufficient for a peck of sprats — 2lb. common salt, 3oz. bay salt, 1lb. saltpetre, 2oz. prunella, and a few grains of cochineal, pounded well together in a mortar; into a stone jar place first a layer of fish, then of the pounded ingredients, and so on until the jar is filled; press them hard down and cover closely. After six months they will be ready for use.

An important trade has sprung up at Lowestoft, in Cornwall, where sprats are being tinned as anchovies. It is said that 3,000,000 tins of sprats, similarly cured as anchovies on the west coast of France, are annually imported into England. Mr. Anderson Smith says that a sardine from the west of France, a small pilchard from Cornwall, or a sprat from the north of Scotland, are practically equally good if equally carefully and skilfully prepared.

When fished for in the sea they are generally taken from close in-shore to about 3 miles out. Sprats are generally taken by means of a large bag-net, made with small meshes, and termed a stow-net, which is placed in a tideway, its mouth towards the tide. Seine and drift-nets are also used for their capture. The stow-net is thus described in the appendix to the Sea Fishery Commission Report (Imperial), 1863-1865: "The stow-net, as generally used, is a funnel-shaped bag, about 150ft. long, with the mouth 30ft. deep and 22ft. wide, the upper and lower margins of the entrance being secured to pieces of timber, termed 'balks.' The net is composed of four parts, each having a different sized mesh, that of the cod, or pointed end of the funnel, being very small. When the net is worked the vessel (at that time called a stow-boat) comes to anchor, just at the turn of the tide, at some spot where there is an abundance of fish, as shown by the presence of numerous gulls and by other signs. The net is then lowered to a certain distance below the surface, and the mouth is kept open and facing the tide by means of ropes from the ends of the balks to the vessel and to the anchor, the long net streaming away under the vessel. In this position the stow-boat and net remain anchored for about six hours, or until the tide is done, the sprats being carried in myriads by the current through the square mouth

of the net, down to the narrow squared extremity. As soon as the watch on deck observes that the tide is becoming slack the mouth of the net is closed by the two balks being brought together. This is effected by means of a chain, made fast to the middle of the lower balk, and leading through an iron loop or strop on the upper one, and thence upwards to a short davit at the bow of the vessel. The net is then brought alongside, and secured there with ropes called girdlines. The cod, or small end of the net, having been hauled on board by the pinion—a rope leading from the cod to the vessel—the end of the net is opened, and the fish are measured out, 3 bushels at a time, into the vessel's hold. This mode of fishing, commonly known as 'stow-boating,' is only carried on from November to February, the time when the sprats enter the estuaries and other narrow waters along the coast. The quantity of fish thus taken is sometimes enormous, and it is found that when the shoals are very large they are almost always composed of sprats; but when these fish come in-shore in small parties they are generally accompanied by numbers of small herrings, and the young of other kinds of floating fish."

STINGAREE (*see* WAIREPO).

SWORD FISH (*Xiphius gladius*).

The sword-shaped upper jaw much depressed and flat. Dorsal fin elevated in immature specimens. In old specimens the middle part of the dorsal and anal fins become very low or disappear, so that there are two fins on the back and behind the vent.

In the early part of January, 1875, a specimen was stranded at Shelly Beach, Auckland, secured, and described by Mr. Cheeseman, since which period its capture or discovery has been comparatively frequent on our coast—sufficiently so, at all events, to cause it to be regarded as one of the fish frequenting our New Zealand waters.

The specimen described by Mr. Cheeseman was over 11ft. in length.

The sword-fish has been popularly portrayed by Chambers as a "genus of fishes," having the upper jaw remarkably elongated and compressed in the form of a sword or dagger. The body is rather of a long shape, and covered with very small scales. There are no teeth; there is one long dorsal fin; there are no finlets; the ventral fins are wanting; the sides of the tail are

very strongly keeled; the tail fin is large and forked; only one species is known (*X. gladius*); plentiful in the Mediterranean and in the warmer parts of the Atlantic; sometimes, but rarely, seen on the British coasts. It is bluish black above, and silvery white on the belly, the one colour passing gradually into the other. It is highly esteemed as an article of food, especially when young. It is harpooned by the fishermen of the Mediterranean, and is powerful enough to drag a boat about for many hours after being struck. It has been said to attack the whale with its sword, but this is extremely improbable. Its food consists in great part of squids and cuttle-fish. The use of the sword is unknown. Instances not unfrequently occur of ships' bottoms being perforated by the sword, but there is no good reason to think that an intentional attack is ever made."

In New South Wales the Rev. Mr. Tenison Woods says: "The sword-fish is very dangerous to the schnapper fishermen." Mr. Oliver states that on two occasions boats lying on the outer grounds were impaled by sword-fish, and the crews only saved their lives with the utmost difficulty.

The Italian fishery is described in the following terms: "This fish (*X. gladius*) is the object of a very peculiar, if not extensive, fishery on the Calabrian and Sicilian coasts, and in the adjacent Strait of Messina, between the months of April and September. These fish, which have the habit of swimming near the surface, and who also travel in considerable numbers in that season, are sighted by look-outs (*antennieri*) usually seated on the very tall masts of peculiar boats (*feluche*); near these are stationed a number of fast boats (*lontri*) with a shorter mast, on which is perched the *foriere*, who follows the direction shouted and pointed to by the *antennieri;* on the prow stands the harpooner (*lanciatore*), and as the boat is swiftly rowed up to the fish he throws his harpoon (*draffiniera*); the wounded fish is followed up by a second fast boat, the first returning near that which holds the *antennieri*. It is a most exciting scene, witnessed once near Messina. It has been described, nearly in the same words, by Polibius, and Spallanzani, and Vetrioli, at an interval of nigh 2,000 years."

"The sword-fish fishery," writes Professor Goode, "is carried on from New Bedford, New London, and several smaller ports of southern New England. About fifteen small vessels are employed in summer, and the yield of their harpoons, together with that of their mackerel vessels, amounts to about 1,500,000 pounds." Mr. Griffin says the flesh is white, well flavoured, and nourishing. "It has found its way into the New York markets," he adds, "the fish being principally harpooned in Long Island Sound."

TARAKIHI (*Chilodactylus macropterus*).

Length about three and a-half times that of the head; six simple pectoral rays, the uppermost reaching to the fourth soft ray of the anal; dorsal notched, seventh spine the longest, rather more than half the length of the head; second anal spine strong, and longer than the third.

Silvery grey, paler below, sometimes reddish purple on the back; a black patch over the base of the pectorals; fins, dusky; iris, purplish.

Of the tarakihi, Dr. Hector writes: "This is a very common fish in the market, and comes into season in September. Two sizes are generally sold during the spring months—the smaller ones, three or four to the pound, being the best; the flesh of the larger fish, which are 3lb. to 6lb. weight, being considered rather tasteless. Throughout the whole year the tarakihi may be caught with the hook in 10 to 25 fathoms water with a sandy bottom."

Captain Fairchild writes that they are chiefly caught about Cook Strait and the Bay of Plenty, while another friend says they are found only on certain grounds "out at sea."

It, however, has a wide range, as Captain Hutton gives its habitat as the Australian seas; and Macleay as Port Jackson, Tasmania, and Port Philip. A fisherman, giving evidence before the Commission in Tasmania, said he had caught them off the islands in the Strait, Kent Group, all round Tasmania, and at Eddystone Point.

The tarakihi is found in the Tasmanian waters, where it is known as the black perch. Mr. Johnston says: "It is particularly an excellent fish—some preferring it to the real trumpeter. The young are caught on the numerous rocky banks, in 3 to 4 fathoms of water, in the upper bays of the estuaries. The young are invariably of a bright silvery appearance, with a conspicuous dark-coloured transverse bar across the shoulder and posterior lobe of operculum, and terminating towards root of pectorals. This bar becomes obsolete or not so conspicuous in the mature form; and this may partly account for some of the confusion which still exists in the classification of this most variable species. The fish take bait readily—the mussel, boiled, being a favourite."

In Sydney it is called the carp, or morwong, where its length varies from 12in. to 18in. The report of the Royal Commission says it is equal to the cod or ling for salting. They are generally caught in deep water on the schnapper grounds.

TREVALLI (*Caranx Georgianus*).

Teeth very small in both jaws, on the vomer and palate; total length four or four and a-half times the length of the head; or about three and a-half times the height of the body; upper jaw rather longer; maxillary does not quite reach to the anterior margin of the eye; breast scaly; lateral line follows the curve of the back and becomes straight below the middle of the soft dorsal.

Above, pale green and purple, with golden and silvery reflections; below, silvery white; a blackish spot on the operculum; top of spinous dorsal blackish.

Dr. Hector says: "The trevalli is the arara of the Maoris, or the trevalli or cavalli of the fishermen. It is a highly esteemed fish, that is very common in every part of the Colony during the summer months, but is in best condition at the commencement and close of the season. Its sides are partially armed with keeled spines like those of the horse-mackerel, but its brilliant yellow tints and deep compressed body readily distinguish it. The flesh is very delicate, but less so in the larger sized fish, about 12in. in length being the best size for the table. The trevalli frequents shallow water and feeds among the rocks, so that it may sometimes be caught by the hand at low water. In Auckland it is sometimes called the yellow-tail, but this name appears to be also used for the king-fish. The fish known as trevalli in the Dunedin market is a different fish, allied to the warehou."

Mr. Thompson describes the trevalli as a constant visitor to the Dunedin fish market during the three years he recorded the fish supply in Dunedin. It was found there 110 days in the year. Mr. Wilson says they are abundant at Kaipara, and smoke splendidly, though they are not adapted for canning. They are occasionally found up to 10lb. in weight, but average from 3lb. to 3½lb. Captain Fairchild says they are comparatively plentiful all round the North Island; while above Kawau and the Barriers they are said to be particularly abundant.

Mr. Johnston, after saying how much they are prized for food in Tasmania, and that only the smaller fish are seen in the local markets, adds that they are caught by graball and seine as a rule, but they take bait rapidly, and may be caught with hook and line. In the *Tasmanian Descriptive Catalogue* it is said the larger fish, 10lb. to 12lb. in weight, are taken in deeper water than in the estuaries.

Mr. Ramsay writes: "The white trevalli (*Caranx Georgianus*) which, on the New South Wales coast, is seldom taken weighing over 1½lb. to 2lb., is found on the shores of Queensland a much greater size, not unfrequently reaching 5lb. to 6lb., and affords fine sport to line fishers; it is also taken with the seine in large quantities. The bait used in line fishing is a blue-bodied crab."

parts, especially on throat and belly. The latter is usually found on a rocky bottom, in shallower water, near shore, and in this state is never found with mature genital organs, and rarely exceeds 6lb. or 7lb. in weight. Unlike the immature bastard, however, the school-fish, or black trumpeter, which is most probably the immature form of the deep coral-reef trumpeter, is held in most esteem as an article of food, and commands a higher price in the market. The fishermen are of opinion that the two forms represent distinct species; but, as the general characters are identical, and as the smaller form caught in shallower water is never found with the genital organs mature, it is most probable that the latter is the immature form of the larger. It is likely, just as in the well-marked type of red bastard trumpeter (*Latris Forsteri*), that they seek the deeper coral reefs as they approach maturity. No other conclusion seems possible, taking all the facts into consideration.

With regard to the exact spawning season and the spawning grounds of the real and bastard trumpeter, little is known. We may recapitulate what has been learned, however, with respect to the former. They are only found with the genital organs in a mature state in the outer coral reefs, 10 to 70 fathoms deep. The school-fish, which are in all probability the half-grown or immature, are, however, found in shallower, rocky bottoms, nearer land, although an odd one of the latter may be caught at times among the mature forms in deep water. It is probable, therefore, that the mature fish spawn on the reefs in deep water, that the young fry afterwards approach the shallower, rocky bottom nearer shore, where they grow up into the stage known as school-fish. As these approach maturity they return to the deep coral reefs from whence they originally migrated. There are several details about the trumpeter, given in evidence by fishermen and others, which do not appear in Mr. Johnston's observations. Thus, Mr. Smith had caught the large fish full of spawn in deep water, and had observed the milt running from them in May and June. The heaviest trumpeter he had ever caught weighed about 60lb. The current on the trumpeter ground is sometimes equal to 5 or 6 knots. The sinkers are 10lb. in weight, with deep water line generally of 80 fathoms; the line, white hemp, ½in. in circumference. Mr. Rush said: "The coral-reef trumpeter swim in large schools. They spawn in deep water in June, July, and August. I have never seen mature ova in fish under 15lb." Mr. Martin had caught trumpeter 16 miles from the mainland, off the reef Pedra Blanca, where the water was shallow —only about 25 fathoms. In 80 fathoms the bite is as distinct as in shallower water. The trumpeter bite is a heavy, solid, sustained bite, repeated two or three times. Spent fish are caught on the same ground about November or December.

TURBOT (*See* FLAT-FISH).

WAIREPO (*Trygon thalassia*).

Tail with a cutaneous fold along the lower side, the depth of the fold being nearly as high as the tail; tail much longer than the body; anterior profile obtuse; large conical thorns, in greater or less number, inserted on a round radiated base, are distributed along the middle of the back, on the scapulary and other regions, and especially on the tail, where they occupy the sides as well as the upper surface; even the cutaneous fold is covered with smaller stellate ossifications.

Concerning the ray family, Dr. Hector writes: "This is a group of fishes not so much appreciated for food as they deserve, and which, though not uncommon, are hardly ever brought to market, at least in Wellington."

To this family of fishes also belongs the formidable stingaree, or wairepo of the Maoris (*Trygon thalassia*), which is greatly prized as food among the Natives, and in some parts of the coast attains to the most enormous size.

Mr. Seymour George gives the following details of the size of one he harpooned at Kawau, in 1880: "Length from snout to tip of tail, 9ft. 11in.; length of tail, 6ft.; breadth, 4ft. 7in.; depth, about 1ft. 6in. It must have weighed," the captor said, "at least 2cwt. The tail was covered with spines; also a row nearly the whole length of the back, and part of two other rows of spines running parallel with the main row of spines on the back."

Mr. Couch, writing of the *Trygon* genus, says that the common variety keeps on the sandy ground at no great distance from land, and in summer wanders into shallow water. It scarcely ever takes a bait. It defends itself by twisting its long slender tail round the object of attack, and tears the surface with the serrated spine, lacerating it in a manner calculated to produce violent inflammation. It appears to be deciduous at intervals (perhaps annually), and to be replaced by another. These spines are sometimes used as a point to arrows and spears, for which they are well fitted. A writer in the *Field*, some years since, said: "In Samoa these ray stings are in high repute still, not only for spear heads (in which case only an inch or two is used, lightly fastened to the staff, so as to leave the point to fester in the flesh), but, they say, as a quaint means of getting rid of an obnoxious chief. You break off some inch or so from the sharp end of the sting, and stick it in a peculiar way in the sleeping-mat. The

obnoxious chief casts himself down to rest, possibly well filled with kava, and the first small barb penetrates his skin; slightly distressed, he turns round again, and a second one enters; and so, tossing and tumbling, he passes the night, till the whole is safe within his ribs, working up like an awn of barley. Soon after he dies with symptoms of general dropsy, with but little external marks to tell the reason why. I know not whether this be true or no; but I do know that it was told me by a Samoan chief, whilst looking over my collection of stings, and more particularly gloating over those of the eagle-ray (*Myliobatis aquila*)."

Captain Moloney, writing in the *Fisheries Literature*, says: "I have with me the caudal and spine of a small sting-ray which was removed from the side of a fisherman of Quittah Gold Coast. In lifting the fish into the canoe it struck him, the spine remaining in the wound. Six hours later the man was seen by one of the colonial surgeons, when the wound presented a very discoloured, unhealthy appearance. The man died six days later from empyœma caused by the wound."

Writing of the poison organs of certain fish, Dr. Günther has stated that such organs are found in the sting-rays, the the tail of which is armed with one or more powerful barbed spines. Although they lack a special organ secreting poison, or a canal in or on the spine by which the venomous fluid is conducted, the symptoms caused by a wound from the spine of a sting-ray are such as cannot be accounted for merely by the mechanical laceration, the pain being intense, and the subsequent inflammation and swelling of the wounded part terminating not rarely in gangrene.

WAREHOU (*Neptonemus Brama*).

Length three and three-fourths that of the head, or two and three-fourths that of the height; diameter of eye equal to length of snout; top of the head fleshy, upper profile convex; præoperculum emarginate; operculum with an obtuse point over the shoulder; pectorals pointed, reaching to third ray of the anal; caudal forked; lateral line curved to the end of the dorsal, thence straight.

Back and sides, greenish silvery; belly, white; snout and top of the head, brownish; pectorals, blackish; base of caudal, reddish.

Of the warehou, Dr. Hector says: "The sea-bream is a fish deservedly prized by the Natives. In Wellington it appears in the market in October, and continues at intervals during the whole summer, but the largest specimens are seen in the North during the winter. It cannot be considered a common fish,

especially in the South, and according to the Natives it is very irregular in its visits to the coast. Those commonly brought to Wellington weigh from 1lb. to 6lb., but in the North, outside Hokianga Harbour, they are sometimes obtained 3ft. in length, in which case their weight would not be less than 25lb. or 30lb. The flesh of the smaller-sized warehou is rich, with a very delicate flavour, and they deserve to be preferred to the tarakihi and young moki, along with which they are generally sold in the market. In Dunedin market, during the autumn months, a closely allied species (*Platystethus Huttoni*) passes for trevalli, but these fish are very small."

In Tasmania the warehou is called the "snogtail trevalli," and are said in the *Tasmanian Catalogue* to be abundant in the months of February, March, and April. They sometimes in a mature state reach a size of 2ft. 6in., and weigh from 12lb. to 14lb., and Mr. Johnston says they are better flavoured when under 1lb. in weight; but in Victoria, where they are imported in quantities from Tasmania, the larger fish appear to be in greater favour. They are taken with hook and line without a sinker.

WHITING (*see* Cod).

YELLOW TAIL (*see* Haku and Red Cod).

Mr. J. Mackenzie to the Hon. Sir Julius Vogel.

"Port Chalmers, 29th March, 1885.

"Sir,—After reviewing the conversation Mr. Thompson and myself had the honour of having with you yesterday about colonial fishery, I think that perhaps it might help you in gaining further information on the subject, unconnected with local or interested opinion, by giving you condensed extracts from my note-books, written at the time I made the examination in each locality. I may here state that the firm of Marshall and Co., who commissioned me to make the researches referred, is now associated with the firm of Gillon and Co. The new departure, so to speak, in Scotch fishing, viz., steam-trawling, has caused the amalgamation of the two firms. Although I have not the authority of the firm for using their name, I do not think there is any harm in doing so.

"Auckland was my first port of call. The intense heat of the climate there, theoretically, is against it as a fish-preserving or curing country for other than the most costly processes of preserving, and the dearest kinds of fish, only suitable, as far as price is concerned, for consumption as a delicacy and rarety by the wealthy. I carefully fished the Firth of Thames, round Cape Colville to Port Charles, Kennedy Bay, and Mercury Bay; found plenty of firm, delicate fish, the schnapper being the only large fish that could be got in anything like large quantities. Examined the coast northwards as far as Whangarei Bay; found schnapper, mullet, kahawai, and bream of fine quality; but, as the weather was so bad, I did not devote much attention to this locality, further than to satisfy myself that fish in countless millions frequent the neighbourhood of Great and Little Barrier Isles, and the Firth of Thames. I crossed overland to Kaipara Harbour. During my visit, the whole harbour from Helensville, at the one end, to Aratapu, at the other end, a distance of over 80 miles, seemed to be actually swarming with the largest and finest mullet in the world. Those fish will not take hook and bait, and are very difficult to net. For tinning this is a fine fish, but, as they are covered with a thick coat of very strong scales, the cost of cleaning them for tinning will, in my opinion, cause the cost of production to be too high to allow it to be sold cheap enough to command ready sale other than as a luxury. I am afraid that it will turn soft in the tin. Although I examined the coast-line from Kaipara Heads to Waitara, near New Plymouth, including the harbour or bays of Manukau, Waikato, Whangaroa, Aotea, and Kawhia, I am not in a position to say that fish always inhabit this region, but I am satisfied that large shoals of schnapper, mullet, and kahawai are to be found here, during some portion of the year in-shore, and most likely off-shore all the year round. I found soles or flounders, kelp-fish, mullet, and bream everywhere in-shore, and also many varieties of small but very excellent fish that I cannot name or classify. After rounding Cape Egmont, rough weather prevented me from fishing until off the Island of Kapiti, and off that island and the Island of Mana I hooked groper, and netted moki and rock-cod, and got also cray-fish, kelp-fish, and butter-fish.

"Port Nicholson, or Wellington Harbour, and Palliser Bay I did not examine, because I got all the information I wanted from the local fishermen and the Wellington fishmongers. From Wellington I went to Nelson, and from thence to Cape Campbell, on the east. I minutely fished all the Picton Sounds, and also tried the off-shore or deep-sea fishing off Cape Campbell. I found the whole of this region actually alive with fish, and the climate more suitable for fish-preserving and curing than north of Cook Strait. The most abundant fish is the Picton herring; not a true herring,

neither is it a true pilchard; but it is a good fish, and adapted for tinning and curing, and, as it is found here in immense quantities, it could be so cheaply procured that the export trade in this article alone should rival in a few years the herring trade from the North of Scotland. Of course this fish, as well as all the herring tribe, is migratory; but fishermen would soon find out its habits, and follow it in its rounds from station to station, as is now done with the Scotch herring. Groper, moki, ling, and cray-fish I also found to Cape Farewell, on the west side. The moki is a good fish for tinning, wet-salting, and smoke-drying; but, as it will not take hook and bait, but has to be caught in nets, and as it inhabits rocky ground, I was not able to ascertain if it is plentiful enough in this quarter to depend upon it for large supplies. From Cape Campbell, on the west, I did not get a chance to try the fishing on the coast, owing to rough weather, until close to off Martin Bay, and here I commenced to meet with fish in such numerous shoals that from there to off Oamaru, in-shore and off-shore, I believe millions of tons of fish could be caught yearly. It is simply a question of proper appliances, and finding out the best and quickest modes of catching the fish; for the fish are there in countless millions, and natural harbours abound from Milford Sound to Oamaru. The Sound swarms with blue-cod, moki, trumpeter, rock-cod, and cray-fish; and off-shore are ling in great quantities, and also groper. Stewart Island coast, in Foveaux Strait, I did not fish, because I got all the information I wanted from a gentleman of the name of Wait, who resided there many years—a very intelligent observer. Ruapuke Isles, off Bluff Harbour, in Foveaux Strait, swarms with moki and trumpeter, but, as the moki has to be netted on rocky bottoms, high winds and rough sea generally prevailing here make the fishing rather dangerous. Chasland's Mistake, on the mainland, commands splendid moki fishing grounds, and also blue-cod, rock-cod, and trumpeter fishing. And here I began to meet with the barracouda in large numbers, and found them all the way northwards to off Oamaru; but off Cape Saunders and Otago Heads seems to be a central gathering-ground for countless millions of those fish for several months in the year. Those fish are caught in a most peculiar manner. The fishermen are provided with strong hardwood rods about 10ft. long; to the rod is attached a strong cord 2ft. or 3 ft. long, and to the end of this is tied a piece of red wood, generally cedar, about 4in. long, $\frac{3}{4}$in. square, and through the piece of wood a common wrought nail is driven and bent back to form the hook. The point of the rod with the line and piece of wood is vigorously kept describing circles in the water. The fish snaps at the piece of wood, and is flung quickly into the boat. As there is no fang on the hooked nail the fish drops off as soon as it is in the boat. Two men fishing, and one man rowing the boat, will often catch

from thirty to forty dozen fish in two or three hours. As the barracouda swim about at great speed, some days it is difficult to follow them about, and if there is a slight sea running the boats now in use cannot work.

"The local fishermen tell me that some seasons all kinds of fish are scarce, but, as the fishing hitherto has only been prosecuted in-shore and in few places, the fishermen do not know much about the habits of the fish. Ling and groper, in great quantities, I found from off Chasland's Mistake to off Timaru. Those fish are found sometimes in-shore, but to get them in quantity they must be fished for off-shore. Otago Harbour commands most extensive and valuable barracouda, groper, ling, rock-cod, and cray-fish fishing, and with proper fishing-smacks Otago Harbour could also command the blue-cod fishing. The kinds of fishes that I have satisfied myself can be obtained in large quantities cheaply, and fit for export trade, tinned, wet and dry-salted, and smoke-dried, are Picton herring, in Cook Strait. Blue and rock-cod, moki, trumpeter, groper, ling, barracouda, cray-fish, cockles, flounders, trevalli, silver-fish, mullet, kelp-fish, gurnard, and about twenty other varieties, including a kind of mackerel, abound on the coast of both Islands, and tinning and curing factories would use all in their season if ever established. But the other kinds I have mentioned, along with schnapper and large mullet of the North Island, are the kinds to make the large trade with; and no other country in the world has such a variety, and distributed round its coast so well. As a central station for fish-curing and fish-tinning, Stewart Island seems to me to be one of the most suitable places in the world. It commands the best in-shore and off-shore fishing-grounds in the Colony. Sawdust, the proper ingredient for smoking, can be obtained in abundance for taking it away. There is plenty of timber and water. All that is wanted is population to supply the labour for tinning and curing factories, and a market for the preserved and cured fish. If capital, aided by Government subsidy, will start operations here, Stewart Island will be one of the wealthiest provinces of the Colony.

"I hope I have been able to state my views so as to be understood by you.

"I have, &c.,

"JOHN MACKENZIE.

"Sir JULIUS VOGEL."

SHARKS.

The sharks, with which our waters abound, are certainly of great commercial value; and what information is to hand on the subject is gathered in the hope that shark-fishing may be prosecuted, not only for its own sake, but for the preservation of other fish which are considered edible by Europeans. And the latter consideration is of some importance, as in Tasmania it is affirmed by the fishermen that the use of deep-sea lines would be valueless there on account of the number of sharks with which the waters swarm.

"In Tasmania," Mr. Johnston says, "certain of them (*Galeus canis*) are captured and the livers boiled down for oil. The fins of this shark are also exported for the preparation of isinglass." Mr. Robert Smith, when giving evidence before the Tasmanian Commission, said: "There were five boats out last week shark catching. They save the fins, take out the liver for the oil, and sell the carcasses for manure. It is a profitable occupation—it pays well. The fins go to Melbourne." Mr. Hill, in the *Sydney Mail*, says: "The liver may be rolled or boiled out; the oil from the former process being said to be of the better colour, and gives less trouble."

Mr. Griffin wrote: "The skins, it is said, are used in the manufacture of jewellery. The skin, when dried and cured, takes a polish equal to that of stone, and bears a strong resemblance to the fossil coral porites. The teeth of the shark are prized by the Natives of the Ellis group and other Islands for their spears and other weapons of war. The teeth of the shark are serrated or saw-edged. A hole is drilled through the upper part of each tooth, which is then tied to a piece of hard wood by means of a strong fibre. The hilts of swords are protected by cross-pieces with the teeth fastened on them in the same way. These weapons make such frightful wounds that the Natives, in order to protect themselves, put on an armour made of rope before going into battle."

The report of the Royal Commission of New South Wales has the following: "The fins always find ready purchasers in the Chinese market; the liver yields a large quantity of excellent oil, equal in quality for medicinal purposes to the best cod liver oil; the skin of some of the species is much in request for

shagreen; and the flesh, though seldom eaten, has been found by analysis to contain much more nutriment than that of any other fish—indeed, to come near to beef and mutton in that respect. They are, of course, very destructive to other fishes, and therefore ought to be destroyed, and the uses just mentioned to which they may be put should strengthen the other inducements to get rid of them."

Mr. Chin Ateak gave some valuable evidence before the New South Wales Royal Commission. "The flesh of the shark," he said, "would not sell in China, cured or fresh, only the fins and skin. The skin was used for sandpaper for carpenters' work; and the fins are boiled down, when a strong juice is got like isinglass. At some places they make it dry—dry it well, to make into soup." The isinglass sells readily at 3s. a pound, and the fins were bought in Sydney at £28 a ton. "A great quantity of fins are used," the witness said, "for, when a large dinner is made, one end of the table is full; and they make it pickled. The tails are not used."

In the Hawaiian Islands, we are told, sharks are caught in great numbers. The Natives seek them in caves below water while the gorged fish sleep with their heads forced into the sides of their resting-places. The diver slips a noose round the tail of the shark, which is then hauled up and dispatched. A Kanaka has been known to seize in this manner six or eight sharks in a day. The oil is extracted, and forms the motive for capture.

The Icelander carries on a large trade in shark oil. A fleet of 100 sail is engaged in this industry. When the shark is caught, its liver is taken out, and the carcass is thrown overboard. In a fortnight or three weeks a vessel will return to port with 120 casks of liver, which is boiled down at a grimy and noisome little shed in the suburbs, and the oil sent to Germany. The Greenland yearly take of sharks is stated to be some 15,000. The industry is carried on with vigour both on the North and West Coasts. Both decked and open vessels are engaged. The species of shark caught is the *Læmargus borealis*, and, according to a writer in *Chambers'*, it is pursued solely for the sake of the oil yielded by the liver, the rest usually being thrown away, though sometimes the flesh is preserved for food. "The sharks vary much in size, running up to 18ft. to 20ft. in length, and 4ft. or 5ft. in diameter through the thickest part of the body, the yield of oil from each liver varying from 4 and 5 up to 50 gallons. Rich livers yield two-thirds of their bulk of oil, poor ones only about one-half. The vessels used in shark-fishing are for the most part schooners of some 30 or 50 tons burden, manned by eight or ten men. The usual fishing season is from January or February till August. During the winter months the sharks

frequent shallower waters, and are found 20 miles from land in 50 fathoms or thereabouts. In summer they seek deeper water, and are caught 100 miles or so off the coast in a depth of 200 fathoms. It having been ascertained by sounding that the ship lies in water of a suitable depth, preferred with a sloping, soft mud bottom, the vessel is anchored and the fishing commences. The hook used is 12in. or 15in. long, baited with seal blubber or horseflesh, weighted with an 8lb. sinker, and attached with a couple of yards of strong chain to an 1½in. line. The hook is allowed to hang motionless about a couple of fathoms from the bottom. As a rule, the sharks are very shy of taking the bait at first, and the fishers may wait long for their first bite; but once the sharks commence to take it, they crowd to the spot and may be hooked in quick succession. They then take the bait greedily, and with little caution. It often happens that a shark which has slipped off the hook after being drawn up to the ship's side and harpooned, takes the bait again after a short interval, and is drawn up with the harpoon sticking in its body. As soon as the shark reaches the surface, harpoons and lances are stuck into it, and the spinal column cut. Large hooks are fixed into the body, and chains passed around it; and, thus secured, it is cut open and its liver removed. Formerly it was customary, after taking the livers, to fasten the bodies astern of the vessel, thus attracting other sharks to the surface, which were harpooned as they rose to feed on their dead comrades. Now the bodies are generally cut loose after the liver has been taken out, and, sinking to the bottom, they attract other sharks to the spot, thus enabling the vessel to lie and fish for a longer time without changing its position. When the livers are brought on shore they are stored in vats until the solid matters have settled to the bottom, after which the more fluid portion is melted in iron pots over an open fire. The oil thus obtained is more or less of a dark colour, according to the degree of decomposition the liver has suffered before melting, and the temperature to which it has been subjected. By this process the liver yields about two-thirds its bulk of a coarse and not very savoury oil. A shark-oil refinery can generally be detected by its odour a great distance. Of late years refining by steam has come considerably into use, and the liver is taken as fresh as possible. By this means a finer, lighter-coloured, and less odorous oil is obtained, though the yield is less. The bodies, too, always contain a considerable quantity of oil, which could probably be abstracted by pressure or other means, and the residual mass made into manure. The crews of vessels engaged in shark fishing are paid about 35s. a month, with a premium of 6d. per barrel of liver. The captain gets 2s. 3d. per barrel on the first hundred barrels of the season's catch, and 3s. 4d. per barrel on the remainder."

Captain Moloney, C.M.G., writes: "Sharks are eaten in Western Africa, as in many other tropical countries; and, when consumption at the time is not equal to available quantity, the surplus is sun-dried or smoked, being treated as are herrings and shrimps.

"In view of the field presented, it is astonishing why sharks are not put to use, as in Norway, where they are captured for their livers; or as in India and China, where the fins form a very important article in trade, the people of the former country preparing from them—in addition to other extracts—gelatine."

In Norway some of the fish furnish livers weighing only from 25lb. to 30lb., while from others livers of 220lb. to 450lb. are obtained.

It is said of Norway that the carcasses of sharks have been of late years brought ashore for the purpose of being manufactured into manure or guano. The mode of capture there is by means of line and hook, baited with seal blubber or some other rancid and strong-smelling bait. The annual yield from this fishery amounts to from 8,000 to 10,000 barrels of livers worth 150,000 gulden. The oil of the shark obtained by steam heating is said to be extremely fine, and is used for purposes of illumination.

At Kurrachee a large fishery is practised. Dr. Buist, writing states that there are fifteen large boats, with crews of twelve men each, constantly employed in this pursuit; that the value of the fins sent to the market varies from 15,000 to 18,000 rupees that one boat will sometimes capture at a draught as many as 100 sharks of various sizes, and that the total number of sharks captured during the year amounts probably to not less than 40,000. Large quantities are imported from the African coast and the Arabian Gulf, and various parts on the coasts of India. In two years 8,770cwt. of sharks' fins were exported from Bombay to China.

Shark fishing is common and popular in the East. Along the coasts of Scinde large nets for the capture of sharks are employed in the comparatively deep sea, a mode of capture more prolific than the hook and chained cord. Shark fins are exported from Ceylon to India; and Zanzibar, we are told, has a large import trade of dry and salt fish, principally shark and scar-fish, while large quantities are cured in the Native villages.

Isinglass is, as most people know, one of the purest of animal glues. For some time its preparation was almost peculiar to Russia. It was made of the air-bladder and sounds of different kinds of fish which are found in the large rivers that flow into the Caspian and North Seas. It was formerly only obtained from the common sturgeon (*Accipenser sturio*), but, as a popular writer says, "the necessities of modern commerce have, however, led to the discovery that the same part in many other fishes forms good isinglass; and instead of Russia, as formerly, being almost the only producing country, it is now brought from and obtained in many others." Isinglass is of great use in clarifying beer and other liquids, and having been found the best gelatine for their purpose, is very largely consumed by brewers. The best is usually rolled in litttle ringlets, the second sort is laid together like the leaves of a book, and the common sort is dried without any care. When fine it is of a white colour, semi-transparent, and dry. It dissolves readily in boiling water. It is also used for stiffening silk, making sticking-plaster, chemical tests, etc.

The preparation of isinglass in Russia, and particularly at Astrachan, consists in steeping the swimming bladders in water, removing carefully their external coat and the blood which often covers them, putting them into a hempen bag, squeezing them, softening them between the hands, and twisting them into small cylinders. They are ready for the market after being dried in the sun, and whitened with the fumes of burning sulphur.

In some districts of Moldavia another process is followed. The skin, the stomach, the intestines, and the swimming-bladder of the sturgeon are cut in small pieces, steeped in cold water, and then gently boiled. The jelly thus obtained is spread in thin layers to dry, when it assumes the appearance of parchment. This is softened in a little water, and rolled into cylinders or extended into plates.

In the matter of fish manure, Mr. Leggatt, in 1869, gave the following evidence before the New Zealand Fishery Commission. He said: "There is a small crustacean resembling a shrimp, and usually known as whale-feed, which frequents our coasts in immense quantities in the season. As a fertilizing agent I have used this, and found it vastly superior to any kind of manure I have ever used—even guano, of which it possesses all the stimulative powers without being exhaustive. It comes in such immense quantities as often to extend as far as the eye can reach, and may be "shovelled" into a boat or small craft by means of hand-nets, under the lee of reefs off-shore. I have always considered that the visitation of this little animal will in time come to be an event of the utmost importance to Otago, as the supply is inexhaustible,

very light of carriage, and in it we have an agent by the employment of which we can defy impoverishment or exhaustion of soil."

Whether Mr. Leggatt over-estimated the fertilizing power of "whale-feed" or not is a question open to inquiry and experience to settle.

In the *Fisheries Literature* we are told that the Americans use menhaden, as sprats are used, for manure. But the Americans, before they put the menhaden on the land, have the wisdom to extract the oil, which they sell for a large sum, and to make the residue into what they call guano. "When fish guano," writes the Jury on Fish Oil and Fish Manure, "was first introduced into agriculture for manuring purposes, farmers complained of its not being sufficiently quick in its action upon growing crops to render it a desirable manure in comparison with Peruvian guano, sulphate of ammonia, nitrate of soda, and mixtures of those fertilizers." This defect was partly due to the coarse mechanical condition in which fish guano was offered in the manure market, but chiefly to the fact that formerly much more oil was left in the residue than at the present time. Oil, it may be remarked, has no value whatever as a manure, and as it retards the decomposition of animal organic matter the practical value of fish guano, to some extent at least, is depreciated by the amount of oil which is left in the guano.

In the United States the use of the refuse has largely increased the profit of the curer. Mr. Earll has demonstrated that the secondary products in the cod fisheries amount to more than 16½ per cent. of the value of the fish as taken from the water, raising the receipts of several important ports by above 100,000 dollars each. 400 tons of fresh cod do not yield more than 120 tons of exported fish; so, from a comparison of the figures, an estimate of the amount of the refuse generally thrown away can be made. One mode of prepartion is by steaming the refuse, and pressing it into cakes, which are dried previous to their sale. In the discussion which took place on the Newfoundland Fisheries, at the Fisheries Exhibition, Captain Curtis, in drawing attention to the question of fish offal, said: Some thirty or forty years ago his father anticipated that the supply of guano would fail, and manufactured several tons of fish manure by mixing the offal with charred peat. In Newfoundland there was plenty of peat, and by mixing it with the offal a very valuable manure might be formed. He had lately become acquainted with a gentleman (Mr. Johnson) who was making 200 tons of fish manure per month, and getting £8 to £11 per ton for it, the works being carried on at Belvedere, below Woolwich. · · · · There

was no nuisance whatever connected with the manufacture. The offal and cuttings of fish were put into tanks at Billingsgate and taken into barges and discharged into receptacles, where it was disintegrated and dried.

Mr. Hounsell joined in the discussion, remarking that twenty-five years ago he was a director of a company formed in the west of Ireland, called the Fishing and Fish Manure Company, the scheme being—not only to fish, but to pay fishermen for fishing and the refuse fish. Every time the trawl was hauled on board there was a large portion, amounting to 60 or 70 per cent., wasted. being either smothered, or of unsaleable kinds, or too small for the market. The whole of this was thrown overboard, and, in many cases, fouled the breeding-places. This scheme was to encourage fishermen to bring this to shore, where it could be converted into manure. The company collapsed for want of supply, but some time afterwards a Mr. Hewitt started the idea of giving the fishermen in the North Sea a bonus for bringing home the offal, and established a factory below Barking, where it was boiled and mixed with a certain amount of charcoal to fix the ammonia. Mr. Hewitt purchased a cargo of this, and took it to Dorsetshire; a portion he employed in growing mangel-wurzel, and gained the first prize at the show, and the remainder he sold to farmers at £14 and £15 a ton.

The following is a list of some of the sharks in the New Zealand waters, concerning which some specific details are appended:—

Family.	Genus.	Species.	Common Name.
Carchariidæ ..	*Carcharias* ..	*brachyurus* ..	Blue shark
	Galeus ..	*canis* ..	Tope
	Zygæna ..	*malleus* ..	Hammer-headed shark
	Mustelus ..	*antarcticus* ..	Smooth hound
Lamnidæ ..	*Lamna* ..	*glauca* ..	Tiger shark
	,, ..	*cornubica* ..	Porbeagle
	Carcharodon	*Rondeletti* ..	White shark
	Alopecias ..	*vulpes* ..	Thresher
	Selachus ..	*maximus* ..	Basking shark
Notidanidæ ..	*Notidanus* ..	*indicus* ..	Perlon
Scylliidæ ..	*Scyllium* ..	*laticeps* ..	Dog-fish
Cestraciontidæ	*Cestracion* ..	*Philippi* ..	Port Jackson shark
Spinacidæ ..	*Acanthias* ..	*vulgaris* ..	Spined dog-fish
	Echinorhinus	*spinosus* ..	Spinous shark
	Scymnus ..	*Lichia* ..	

BLUE SHARK (*Carcharias brachyurus*).

Colour uniform. Grows to length of 12ft.

TOPE (*Galeus canis*).

Uniform greyish, lighter below.

Common.

Temperate and tropical seas.

Mr. Macleay is of opinion that the Australian form is specifically distinct from the European form, and calls it *Galeus australis*. It is the "school-shark" of the Sydney fishermen. Its length is about 6ft.

A specimen was caught in Preservation Inlet in 1875. Of the Australian species the Rev. Mr. Tenison Woods writes: "It grows to about 6ft. long, and has become an article of export from Tasmania. It is regularly captured at Southport and Recherche Bay. At a visit paid by the writer to that locality he found about ten families engaged principally in the shark fishery. The portions used were the liver (which was boiled for oil) and the fins (which were dried and pressed for the Chinese market). There were two very intelligent Chinese agents who bought the fins on the spot, and undertook the water transport to the place of shipment. They gave much information about the trade, which just then happened to be in a depressed state. The tail fin is not used, and of the others the dorsal fins were the most esteemed, and were packed separately. The fishermen found it sufficiently remunerative to engage in no other fishery. Fish oil," he adds in a note, "absorbs oxygen so rapidly, and thickens to an extent which precludes its application to machinery."

HAMMER-HEADED SHARK (*Zygæna malleus*).

Tropical and sub-tropical seas.

Length from 8ft. to 12ft.

In New Zealand this species seems to be confined to the northern portions of the Auckland Provincial District. Several specimens have been caught in Auckland Harbour itself, and it is not infrequently seen in the Hauraki Gulf, off Whangarei, the Bay of Islands, and other localities on the north-eastern coast of the island.

Chambers describes the genus *Zygæna* as a genus having the general form and character of the shark family, but distinguished from all other fishes by the extraordinary form of the head, which in the adults resembles a double-headed hammer, being extended on both sides to a considerable length, and having the eyes at the ends of the lateral extensions. The mouth is below, in the centre of the head. The hammer-headed form is not so perfect in the young as in the adult. It is supposed to be an enlargement of the field of the sphere of vision. In the fœtal state the lateral extensions are doubled upon themselves. The hammer-heads are ovo-viviparous and produce many (about forty) young at a birth. They may be, in some places, seen ascending from the clear blue depths of the ocean like a great cloud. They are very voracious. Some attain a great size. "Its habits," Jardine says, "are very similar to those of the other large sharks, not hesitating to attack man when the opportunity offers. It is said, however, to feed on the rays in preference to any other kind of food. The flesh is very hard and leathery."

TIGER SHARK (*Lamna glauca*).

In New South Wales it is called the blue pointer, and, as Mr. Hill tells us, is "not only a very powerful, but perhaps the most bold of any of the large sharks visiting our shores. It grows to the length of 10ft. to 12ft., but is not so big in the girth as the others. On the appearance of a 'blue pointer' among boats fishing for schnapper outside, the general cry is raised, 'Look out for the blue pointer!' This fish exhibits cunning, and seizes the hooked fishes when they are near the surface, at which time they are nearly exhausted, and bites them off just below the hook in an instant, leaving only the head, which has the appearance of being cut off with some sharp instrument. The great danger of these fishes is that in their speed, and blinded by the eagerness of pursuit, they may miss the object and go clean through the boat, or into it, as they have been known to jump high into the air. In such a case the whole crew would in all probability be destroyed by this one's attendants. Sometimes they have been known to leave their teeth in the hardwood of the keel or stern-post of the boat, no doubt having missed their aim; but when this occurs they make the boat shake from stem to stern. These are high-swimming fishes, and may be readily seen when about pushing their pursuits; the beautiful azure tint of their back and sides, and independent manner they have of swimming rapidly and high among the boats, in search of prey, are means of easy recognition, and they often drive the fishermen away. They have a longer and sharper nose than the 'sea-

shark,' or 'nurse,' and appear to be very active, and bold enough to come straight on after they have had a good blow. They appear to be very keen of scent, and altogether they are objects of interest. Various people in this, as well as in other colonies, have been fearfully mutilated by sharks, sufficiently, in some instances, to cause death very soon."

Although there is some doubt on the subject, *Lamna glauca* is considered to be the mako of the Maoris, which is mainly found in the neighbourhood of Mayor Island. "About a mile," Mr. Gold-Smith writes, "from Rua Kekino (on Mayor Island) is situated Karoa Bay, ... the home of the mako, a small shark much prized by the Natives for its teeth, which they use as ear-rings. These mako, however, are not often caught." Here, it will be seen, the writer calls it a "small" shark, but Dr. Haast, who thought the mako was *Lamna cornubica*, writes how two Natives from Poverty Bay told him that, when in an adult state, it was about 12ft. long, which agrees with the length acquired by *Lamna glauca*.

The Urungawera hapu of the Ngaiterangi were the occupiers of Mayor Island in times past, and for that matter are the owners now, though sadly dwindled down in number. Last year they only numbered nine, while in 1838, Judge Wilson tells us, their total was seventy. But these people did almost all the trade with the sharks' teeth, which are so well known as a Maori ornament throughout the islands of New Zealand, having almost a monopoly, because the mako was rarely found in other places. The teeth, never plentiful, varied in value, according to size, and the pendant is called "ngutukao."

The teeth used to be extracted after the head had been cooked in a "hangi." Before the introduction of sealing wax nothing was used by the Natives to cover the fangs, but a small round piece of "paua" shell was inlaid on each side of the tooth. Narrow strips of dogskin were used, before black ribbon came in vogue, for suspending the "ngutukao" from the ear. The mango was also found at Muriwhenua (the North Cape). The season for catching extended from November to February. The fish was not eaten by the captors, though it may have been dried and sent inland, as was the custom of shore Natives with inferior kinds of sharks. In fact, several kinds of sharks were not eaten by the shore Natives, but were frequently, when caught, dried with the dog-fish and other edible species, and supplied to tribes resident some distance from the coast. The common dog-fish was caught in large numbers in December and January, and dried for food. Some ten or a dozen years since a mango, some 7ft. long, was found at Coromandel, much to the surprise of the Natives at so unusual a visitor. Mango, it should be remembered, seems

almost a generic name for shark in the North, as there is the mango-taniwha, a large variety; the mango-pare, the hammer-headed shark; the mango-reremai, the common dog-fish; the mango-pekepeke, and the mango-aruroa. The liver of one or more of the sharks, when eaten, caused the skin of the eaters to peal off. Sharks' teeth were used by the Natives as one of their substitutes for knives, as will be known by a remembrance of the threat of the Ngaitahu chief Te Rerewaka, that, if Rauparaha ever set foot on his land, he would rip open his body with a shark's tooth (*niho mango*).

PORBEAGLE (*Lamna cornubica*).

It has two dorsal fins, the first about the middle of the back, the second near the tail. The tail fin is large and forked. The head is pointed. The gill openings are large. The teeth are flat, triangular, smooth, sharp, and cutting. It attains a length of about 6ft. Small companies associate in pursuit of prey, which consists of fish of various kinds. No creature is more voracious; three large hakes have been found in the stomach of a porbeagle.

WHITE SHARK (*Carcharodon Rondeletti*).

General appearance of the *Lamna glauca*, with the same form of snout and tail, but differs in having the teeth, though as long, much broader and compressed and serrated. The eye is situated more over the front of the mouth. The first dorsal fin nearer the pectoral fin, which is much longer, but not falciform. The keel on each side of the tail is longer and not so wide, and the lower lobe of the caudal is almost, if not quite, as long as the upper.

Colour, pale bluish-grey.

Australian seas and Port Jackson.

Greatest length, 36ft.

THRESHER (*Alopecias vulpes*).

The third tooth on each side of the upper jaw much smaller than the others; pectorals, large falciform.

Mediterranean, Atlantic, Cape of Good Hope.

The snout is short and conical; the spout-holes are very small; he mouth is not so large as that of the white shark, nor the teeth so formidable; but it is extremely bold and voracious, readily attacking grampuses and dolphins much larger than itself. Its most remarkable peculiarity is the great elongation of the upper lobe of the tail-fin, which is nearly equal in length to the whole

body, and into which the vertebral column extends. Of this, it makes use as a weapon, striking with great force. It is said to be not uncommon for a whole herd of dolphins to take flight at the first splash of the tail of the fox-shark. From the use it makes of its tail it has acquired the name of "thresher." It attains a length, tail included, of 13ft. The body is spindle-shaped.

BASKING SHARK (*Selachus maximus*).

The basking-shark is by far the largest of our native fishes, frequently measuring upwards of 30ft. Several of its characters are very strongly marked. The teeth are conic, simple, and rather small for so large a fish. The under lobe of its tail is much smaller than its upper, which makes the caudal appear nearly regularly lunate. The branchial apertures are very large, and almost encircle the neck. The tail and fins generally are rather small, but they do not prevent it swimming with considerable velocity when occasion requires. Usually, however, it is not much given to locomotion, delighting either to move slowly along the surface, with the dorsal fin above water, or even to repose in perfect stillness, commonly with the back, but at times with the belly, uppermost, as if enjoying the light and warmth. It is this habit which has led to it being called by some the sun-fish, and by Pennant the basking-shark, a name now generally adopted. It is likewise named the sail-fish. They will permit a boat to follow them without accelerating their motion till it comes almost within contact, when the harpooner strikes his weapon into them as near to the gills as possible; but they are often so insensible as not to move till the united strength of the two men has forced in the harpoon deeper. As soon as they perceive themselves wounded they fling up their tail, plunge headlong to the bottom, and frequently coil the ropes round them in their agonies, attempting to disengage the harpoon from them by rolling on the ground; for it is often found greatly bent. As soon as they discover that all efforts are vain they swim away with amazing rapidity, and with such violence that there has been an instance of a vessel of several tons having been towed away against a fresh gale. They sometimes run off with some 200 fathoms of line, and with two harpoons in them, and will employ the fishers from twelve to twenty-four hours before they are subdued. As might be inferred from its less formidable armature of teeth, the basking-shark is less voracious than its congeners, feeding on the roe of *echini*, *medusæ*, and, according to Pennant, marine plants. The liver is of large size, and in one fish, measuring 26ft., yielded 150 gallons of oil. In other instances eight barrels of oil have been procured. From this source the fishermen have sometimes realised a profit of £20 from a single fish.

Mr. Kent says: "It makes a regular migration along the west coast of Ireland and western isles of Scotland during the spring months of the year, and, on account of the value and quantity of the oil obtainable from its liver, is the object in such localities of an important fishery. Although of such enormous bulk, it is a very quiet and inoffensive species, armed with teeth scarcely larger than those of an ordinary dog-fish."

Until lately the basking-shark was supposed to be confined to the north temperate zone; but Professor McCoy, of Melbourne, has noted its occurrence in Victorian waters; and a few months ago a specimen 33ft. in length was stranded at the Wade, and brought to Auckland for exhibition.

PERLON (*Notidanus indicus*).

A specimen of this shark is in the Auckland Museum.

DOG FISH (*Scyllium laticeps*).

The dog-fish is abundant in the New Zealand waters, though only one species has been described—namely, *Scyllium laticeps;* but as the *Scylliidæ* in habit are in all probability much alike, details concerning other species may be considered as applicable to *S. laticeps.* Thus, accustomed to prey upon crustacea and other animals inhabiting the bottom of the ocean, dog-fish are known as "ground-sharks." Mr. Kent says: "The ground-sharks deposit eggs, usually two at a time, enclosed in horny cases, several inches long, not unlike those of the skates, but having their extremities produced into long cord-like tendrils, which, during deposition, are wound tightly round stones, sea-weeds, and other submarine objects, the eggs being thus securely anchored until the escape of the young fish. The gradual development of the young dog-fish, which in its earlier days possesses tufted, external gills, like a tadpole, may be distinctly observed through the more transparent egg cases, and affords one of the most interesting and instructive exhibitions furnished by a well-ordered aquarium."

"The dog-fish," Mr. Holdsworth says, "is a great enemy to the cod fishermen, which at certain times, but fortunately not every year, commit great havoc among the cod which have been hooked. One case is recorded of nearly every fish on the line having been more or less eaten by the "dogs," and the smack returned to harbour with her rigging covered with skeletons. Of

six and a-half score cod on the line, only six fish were found alive. The clearer the water the more danger there is from the dog-fish, as the cod can be seen at some distance when struggling on the hook, and once having attracted attention there is little hope of escaping their enemies."

In England and other places the dog-fish furnish a type of shagreen, much used for polishing hard surfaces, and oil is extracted from the liver of the larger spotted species. As some of those who have caught dog-fish know, if you stroke the skin the right way it is as smooth as satin; but if you reverse the process you get a wounded hand.

PORT JACKSON SHARK (*Cestracion Philippi*).

This shark attains to the length of 4ft., and is perfectly harmless, although at the same time "it is armed, at the front of each dorsal fin, with a strong pointed spine. The head is bony and hard, and the mouth is filled with a pavement of crushing teeth, curiously formed, and it seeks its food either among the crevices of rocks or on the ground, foraging about for shell-fish—cockles, crabs, and other crustacea—and at times will examine the edges of rocks, just above water-mark, in search of shell-fish, which its powerful jaws and teeth, or plates, are admirably adapted for crushing.

It was supposed that Port Jackson alone had this shark, and that it is the living representative of fish which once populated the Northern Seas, wherein the fossil remains are found in multitudes. It has since been found in many of the coast bays of Australia, and there are said to be two distinct species, the one much darker than the other.

"I had occasion to catch it, and tried Long Bay and Botany Bay for that purpose, and was successful at both places. At Jervis Bay, also, I succeeded in shooting one in the head, whilst in the position of searching the rocks, with its head out of the water. They are also frequently hauled in with the net, and caught also with the hook and line, but are of no use, and only interesting from the fact that they are said to be the living representatives of what are found in fossil remains." The writer is Mr. Hill, in the *Sydney Mail*.

SPINED DOG FISH (*Acanthias vulgaris*).

Grey, with large white spots that fade after death.

Common; female about 3ft. in length, males 2ft.

The most common, it is said, of all the sharks. It is affirmed that on the coast of Cornwall as many as 20,000 have been taken in a net at one time. Bloch states that the young are spotted with white. Mr. Couch informed Mr. Yarrell that for the purpose of using its spine, the spined dog-fish bends itself into the form of a bow, and by a sudden motion causes them to spring asunder in different directions; and so accurately is this intention effected that, if a finger were placed on its head, it would strike it without piercing its own skin. Low states that, when caught, the fish wreathes itself round the fishermen's hands, and, if they are not attentive, often wounding them very severely, which—if it happens in a part near a joint—is always dangerous and bad to heal, making the part to swell and look very red and fiery, and often endangering a gangrene. However this may be, the fishermen always fear these dreadful weapons, and when the fish is hooked and brought up, commonly catch it by the tail, and, with a smart jerk against the edge of the boat, disable it. It is troublesome to fishermen from its numbers and voracity, by destroying their bait and lines, and becoming entangled in their nets in the room of more valuable captures.

Oil is made from the liver of this fish, its refuse is used for manure manufacture, and its rough skin used to be used for polishing wood. "It is, in places," Mr. Day says, "dried and salted, and although rather strongly tasted, is largely used as food in the Hebrides, where it is sold as 'Darwin Salmon.' It is prepared by being cut open and dried while it is so full of oil that it does not decompose. In the West of England, both fresh and salted, it is a very common article of food with the fishermen."

John M. Paul Du Chaillu was, in what he calls "The Land of the Midnight Sun," when he went to Slamsund to see how cod-liver oil was manufactured, and the process he thus describes: "Several men were engaged separating the good livers from the bad; all were fresh from fish caught that day. The fat and healthy livers were whitish, while the diseased ones were greenish, and the lean ones red. I was surprised to see the number of diseased and lean livers. The men were very particular in selecting the choicest kinds. After they had been assorted, they were put into a large tank, washed thoroughly in warm water, and then placed over an open wire net to let the water drip away. There were five large high rounded kettles or vessels, surrounded by steam at a pressure never exceeding 5lb. By this process the livers boil very slowly for eight hours, after which the oil is filtered twice through cotton, and put in large tins tightly soldered. The product was clear and white, and appeared to me perfectly pure, but the process does not end here. The oil is shipped to Christiania, where it undergoes chemical treatment, which frees it from the microscopic

globules of blood and from stearine; it is then filtered through paper, and is ready for the market. Some sort of brown oil is made from the residue, and what is left after this is manufactured into a fertilizer, which is said to be very rich. The process has nothing of the repulsiveness of the method by which brown oil is usually made—namely, by letting the livers rot, skimming the oil, and afterwards boiling it."

In the preparation of the oil by the rotting of the livers, Chambers tells us that it is done in this way: "The livers are placed in a tub with a layer of spruce boughs at the bottom, and subjected to pressure, when the light-coloured or pale oil exudes and is run off by an opening at the lower part of the tub. As the livers partially putrify, more oil escapes, which is darker than that procured from the fish livers, and constitutes the pale brown oil; whilst the residual livers, being boiled with water, part with the remaining oil they contain, and yield the dark brown oil. The pale oil thus approaches more nearly the condition in which the oil is present in the livers, while the other varieties are more or less impregnated with the products of the putrefaction of the livers." The cod-liver oil of commerce is not only obtained from the cod, but from allied species—ling, dorsk, coal-fish, etc. The liver of the grey mullet in our waters is rich in oil, and here it may be said that their livers are as frequently diseased as are the livers of the cod in the northern hemisphere.

SPINOUS SHARK (*Echinorhinus spinosus*).

In *The Transactions of the New Zealand Institute*, vol. xvi., p. 280, appears the following: "This species is stated by Günther to be confined to the Mediterranean and Atlantic, extending from the coast of England to the Cape of Good Hope. I believe the present specimen to be the first which has been recorded beyond the usual range. It was caught off Dunedin by fishermen in the employment of the Deep Sea Fishing Company during the present month (July 1883). The fish, which was quite new to the captors, was cut up for bait."

Jardine says: "This fish appears to be nowhere abundant, but it has long been known to ichthyologists. The first notice we find of it is in *The Proceedings of the British Association at Newcastle in* 1828, where a description was given by Arthur Strickland, Esq., of a specimen found on the Yorkshire coast. Since that time four others have occurred—one in Filey Bay, Yorkshire; another near the Land's End; a third near Brixham; and a fourth near Berry Head. It varies in length from 4ft. to 7ft. or 8ft., and also in the proportionate thickness of different parts of

the body—results which are no doubt to be ascribed to difference of age in the individuals described and figured by authors. The most remarkable peculiarities are the position of the first dorsal, which is opposite the abdominal fin, and the numerous spines scattered over the surface of the skin. These spines exactly resemble the prickles of the stems of the rose-bush, being conical, generally curved, and rising from a broad, circular base, which is marked with radiating striæ. They are said to be the most numerous in the males. The teeth are regularly placed on each jaw, only one in use at a time, the rest reclined; they are large, compressed, and somewhat quadrangular, and cutting edges nearly horizontal, and both of their sides are generally tricuspidate. This shark is described by fishermen as being sluggish and unwieldy in its movements, and but seldom to be observed towards the surface of the water. When they obtain specimens, it is generally at a time when they are fishing in deep water, and when the bait, with which the hooks are armed, is near the bottom. In this respect it resembles *Scyllia*, or ground sharks; and, if we were to regard only its internal organisation, we should be disposed to consider it as closely allied to that genus."

Scymnus Lichia.

Mr. Parker writes in *The Transactions of the New Zealand Institute*: "The shark (*Scymnus Lichia*) is stated by Günther to be confined to the Mediterranean and neighbouring parts of the Atlantic. Its range must now, however, be extended to include the South Pacific, since the specimen from which the following notes were made was caught off Pilot Beach, near Otago Heads, by Coxswain Milne. *Scymnus Lichia* must, therefore, be added to the list of marine fishes, inhabiting both the Northern and Southern Oceans." The "notes" mentioned are not of general interest.

RAYS.

In the table following will be found a list of rays inhabiting New Zealand waters. The skate and stingaree are noticed in their places among the edible salt-water fishes. All the stingless rays are useful as food, though not generally in favour among Europeans. Dr. Günther, in his *Study of Fishes*, says: "In the family *Batoidei*, or rays, the body is excessively depressed, and forms, with the expanded pectoral fins, a somewhat circular disc, to which the tail appears as an appendage of varying length. In the families *Pristidæ* and *Rhinobatidæ*, the habit is that of sharks; but the gills are placed underneath instead of at the sides. In all the anal fin is absent, and the dorsals are on the tail. True rays lead a sedentary life on the bottom; they swim by the fins, and the tail serves merely to steer them. The mouth is entirely at the lower surface, so that the prey is not seized by the mouth, but the fish darts over it, and holds it down with its body, and conveys it subsequently to its mouth."

Mr. Day says: "These fish, from the nature of their skins, which continue to exude mucus for some days after death, do not take salt well, and are consequently dried by being hung up in the air. This 'sour skate' is universally used in the Highlands, and in the Isles, forming a favourite article of diet. Shagreen may be prepared from the skin of some of them, or from that of a shark; but it is now artificially manufactured from the skin of an ass, or horse, scraped thin, and into which seeds are beaten. It is a long process, carried on at Astrachan."

Of the torpedoes, Mr. Kent writes: "The remarkable feature concerning these fish is their possession of a complex electrical apparatus. This apparatus, which is developed in equal proportions on each side of the anterior region of the body, consists, as described by Professor Huxley, 'of nearly parallel lamellæ of connective tissue, enclosing small chambers, in which lie what are termed the electrical plates. These are cellular structures, on one face of which the final ramifications of the nerves that supply the electrical organs are distributed.' When laid open with the dissecting knife this electrical apparatus presents to the ordinary observer much the appearance of a honeycomb, being composed of numerous perpendicularly-set hexagonal compartments, the wax walls of the honeycomb being

represented by a gelatinous membrane of extreme tenuity, and containing within them a transparent fluid of jelly-like consistence. Finer transverse partitions, or septa ('the electrical plates'), subdivide the hexagonal compartments into smaller chambers, which subserve the purpose of store cells, after the manner of a Leyden jar, and in these the electricity, converted from nervous energy, is stored up for use. There can be but little doubt that the torpedo employs its formidable battery for disabling and securing food, which it is too inactive to capture by ordinary means."

Mr. Hill writes of a torpedo caught in Sydney Harbour: "On one occasion, when we were more inclined to play than to assist with net, we amused ourselves with a large torpedo, which had been hauled in. Four of us, after feeling a shock individually, joined in a circle, holding hands, and those at the extremity touching the fish. Simultaneously we completed the circle, and experienced a shock similar to that from a galvanic battery. On another occasion, and at another place, we endeavoured to continue some experiments on one of these fishes, which had been caught, but it was so enfeebled that the shock was scarcely perceptible. This we attributed to having expended its power upon the net, with which it had been in constant contact during the capture. In about half an hour afterwards the fish had apparently somewhat recovered, as the shocks were appreciably stronger, but ceased with death."

The rays of New Zealand are:—

Family.	Genus.	Species.	Common Name.
Rhinobatidæ ..	*Rhinobatus*	*Banksi*	
"	*Trygonorhina* ..	*fasciata*	The Fiddler
Torpedinidæ ..	*Torpedo*	*Fairchildi*	
"	"	*fusca*	
Rajidæ	*Raja*	*nasuta*	Skate
Trygonidæ	*Trygon*	*Thalassia*	Stingaree
"	"	*Kuhlii*	
"	"	*brevicaudata* ..	
Myliobatidæ ..	*Myliobatis*	*Aquila*	Whip Ray
"	"	*tenuicaudatus* ..	

THE FIDDLER (*Trygonorhina fasciata*).

"The fiddler," Mr. Woods writes, "otherwise a harmless fish, is a great pest to the fishermen at times in the harbours, readily and quietly taking the bait intended for some other fish of

a more useful character. Like all the shark tribe, they have a very powerful scent, and seize the bait by overlying it with a mouth which is well underneath. These fishes, if not very cautious in their movements at this time, are struck by the line, and the hook very often pierces some other place than the mouth, on the under part of the body."

The fiddler is said to make excellent skate.

Trygon Kuhlii.

Tail with a distinct cutaneous fold above and below, about one-half longer than the disc; the margins of the snout form an obtuse angle; body entirely smooth, or with a series of spines, pointing backwards, along the median line of the back to the caudal spine; only two appendages at the bottom of the mouth, behind the teeth; upper parts with some scattered bluish black-edged ocelli.

WHIP RAY (*Myliobatis Aquila*).

Extensively distributed, and examples have been found measuring 15ft. in length, and weighing 300lb. It swims pretty rapidly, with a kind of sailing motion, and little action of the pectoral fins, and when taken vibrates its tail violently; the first care of the fishermen, therefore, is to cut off the caudal spine, which, in a specimen approaching the dimensions given above, is a very formidable implement.

Myliobatis tenuicaudatus.

Tail shorter than the disc; very slender. Dorsal finlet commences before the posterior limit of the ventrals. Claspers extend to the caudal spine, which springs half the length of the dorsal behind that fin, and is equal in length to its base. Body slopes gradually into the fin portion of the disc; head elevated; eyes lateral, but without an overhanging ridge. Nasal disc rounded, blunt; profile of mouth concave, and equal in length to the orbital interspace.

Colour dark brown, with blue bars; white beneath.

FRESH WATER FISHES.

Dr. Hector writes: "The fresh waters of New Zealand are inhabited by only a few kinds of fish, as compared with most other countries, and they are mostly of small size. Nevertheless, from their abundance at certain seasons, some species are of considerable importance as sources of food, and in a few cases possess more interest for the angler than is usually conceded to them."

The bulk of the authentic information which follows is from the same source.

BULLHEAD (*Eleotris gobioides*).

Length three and a-quarter or three and a-half times that of the head, or four and a-half or five times the height of the body; interorbital space flat or concave; scales minutely ciliated.

Blackish brown, with a light-coloured vertical band across the root of the pectoral fins.

Common in rivers and lakes, Captain Hutton states, and adds: "This species is exceedingly variable in the size of the eye, the size and shape of the interorbital space, and in the colours, being sometimes washed with yellow and sometimes entirely black. At first sight it would appear that at least three species could be made out, but after a careful examination of a large number of specimens from many parts of the country, I can find no constant distinction between them, some specimens exhibiting intermediate characters, connecting others which appear to be quite distinct. The proportion between the diameter of the eye to the interorbital space varies from one to one-half."

EELS.

Eels belong to the *Murænidæ* family, which is thus described: Body, very elongate, cylindrical or band shaped, naked or with rudimentary scales; gill opening very small; vent remote from the head; no ventral fins; vertical fins, if present, confluent, or separated by the projecting tip of the tail. The humeral arch not attached to the skull.

"Their attenuate, snake-shaped bodies, absence of ventral fins," writes Mr. Kent, "and the continuity of the long dorsal and anal fins, distinguish the members of the eel tribe conspicuously from all other fish."

In 1880, Dr. Günther wrote of the fresh-water eels: "Their mode of propagation is still unknown. So much only is certain, that they do spawn in fresh water, that many full-grown individuals, but not all, descend rivers during the winter months, and that some of them, at least, must spawn in brackish water, or in deep water in the sea, for, in the course of the summer, young individuals, from 3in. to 5in. long, ascend the rivers in incredible numbers, overcoming all obstacles, ascending vertical walls or floodgates, entering every larger or smaller tributary, and making their way even over *terra firma* to waters shut off from all communication with rivers. Such immigrations have long been known by the name of 'eel-fairs.' The majority of the eels which migrate to the sea appear to return to fresh water, but not in a body, but irregularly, and throughout the warmer part of the year. No naturalist has ever observed these fish in the act of spawning, or found mature ova; and the organs of reproduction of individuals caught in fresh water are so little developed, and so much alike, that the female organ can only be distinguished from the male with the aid of a microscope."

Two years, at least, later, Mr. Howes, writing categorically, states another version of the habits of the eel, saying: "After strange oscillations between fact and fiction, the question stands thus: The ripening fish leave for the sea in the autumn, and after an absence of five or six weeks they spawn—in some cases on known mud-banks. In the spring the young ones begin to come up the rivers, with an experience of eight or ten weeks of marine life, to enter upon a fluviatile existence. The parents, however, do not appear, and the only supposition is, that, like the lamprey, they spawn and then die. First among the difficulties of actually demonstrating the ripened male organ, is that of capturing an eel in the deep and open sea."

These prefatory quotations are necessary, because eels, as yet, are one of the unsolved mysteries of the world. For a long period the most crude theories prevailed as to their mode of reproduction.

Of the genus *Anguilla* there are three species in New Zealand, named and described by Captain Hutton. Their descriptions follow, but to determine to what species the varieties named by the Natives belong is beyond the scope or purpose of these pages, or the capacity of the compiler.

Anguilla Aucklandii.

The length of the head is contained one and three-fifths in the distance between the gill openings and the origin of the dorsal fin, and rather more than twice in distance between the gill openings and the vent; dorsal commences at a distance before the vent, which is contained one and two-fifths in the length of the head; lower jaw longer; angle of the mouth behind the hind margin of the eye, which is much smaller than the snout; tail longer than the body in the proportion of eight to seven; *vomerine band of teeth tapering backwards, and extending as far or nearly as far back as the maxillary teeth.*

Above, dark greenish or greyish black; below, light grey; paler on the chin and throat; iris, yellow.

Abundant all over New Zealand, sometimes attaining a length of 6ft., and as much as 70lb. in weight in one instance, caught many years since in Lake Wakatipu. Captain Hutton writes: "In the Waikato, large numbers go down to the sea in February and March to breed, although many remain in fresh water all the year round. The young eels come up the river at the end of November, just after the whitebait."

Anguilla latirostris.

The length of the head is contained once and a-half or once and three-fourths in the distance of the gill openings from the origin of the dorsal fin, and twice and a-half in its distance from the vent; distance between the commencement of the dorsal and anal fins shorter than the head; lips broad and fleshy; lower jaw prominent; angle of the mouth below the hind margin of the eye, which is rather small, much shorter than the snout; tail considerably longer than the body; mandibulary teeth in a single band, without longitudinal groove.

Mr. Henry Travers, Captain Hutton says, brought three specimens of this eel from the Chatham Islands.

This eel is found apparently all the world over, being known as the broad-nosed eel. The habits of this species, Jardine says, differ in scarce any respect to that of the common or sharp-nosed English eel. Its principal marks cf distinction consist in the snout being depressed and comparatively large, the nose broad and rounded. The skin is said to be thicker than in the common eel, and is the variety known in England by the name of "grigs." They are not as much esteemed as *A. acutirostris*, and not often exceed 3lb. or 4lb. in weight. The largest Mr. Yarrell had seen did not weigh more than 5lb.

Anguilla australis.

The length of the head is contained two and a-half times in the distance between the gill openings and the vent; dorsal commences at a distance before the vent, which is contained five times in the length of the head; lower jaw rather longer; angle of the mouth rather behind the posterior angle of the eye; tail longer than the body, in the proportion of eight to five and four-fifths; vomerine band of teeth short, not quite reaching to the anterior margin of the eye.

Olivaceous brown; white below; dorsal and anal, whitish.

Dr. Hector writes, in his *Notes on Edible Fishes*: "Several species of the eel are found in the New Zealand rivers, *Anguilla Aucklandii* and *A. australis* being the most common. The former grows to a very large size, and is largely used by the Natives and persons living in the remote districts for food, but is rarely sold in the towns. The quality of the flesh of the eel differs greatly in different streams, and there are some singular facts respecting its distribution which are not yet fully understood. Thus, eels are not found in Taupo Lake, although they are common in streams only a few miles distant that flow direct to the sea by the Rangitaiki River. The Natives have repeatedly carried eels across this gap, in the hope of acclimatizing them, to the waters of the lake, but they are never again seen. Mr. W. T. L. Travers has directed attention to a similar circumstance in certain rivers of the South Island, under conditions which indicate that the eel cannot survive without free access to the sea. Respecting the existence of an obstruction in the course of the Waikato that will prevent the eel ascending and descending from Taupo Lake, Mr. Maling, who is surveying in that district, has written to Mr. Travers as follows: 'In looking over *The Transactions of the New Zealand Institute*, I see that you make inquiries about eels being found in rivers below rapids, and not above them. From my own observations I think it is absolutely requisite for that fish to have access to the sea. There are three notable instances of it near here. 1st. In the Waikato River, eels are found as far as Maungatautari Falls, and in all the streams that flow into it below them. 2nd. In the Kaituna River, which drains Rotorua and Rotoiti Lakes, eels are caught as far as the falls below the Taheke, and no further. 3rd. They are caught in Lake Tarawera, but not in Rotokakahi, the waters of which run into Tarawera Lake, but have a perpendicular fall in one place of over 100ft. The Natives also say that unless the fish can get to the sea it will not be found. Rapids, unless of great length, and the waters much confined, are not sufficient to prevent them ascending; and I have also met them on land where vegetation is rank, and wet with dew or rain.

It is my own opinion that eels spawn near the mouths of rivers, as I have several times seen immense shoals of young ones, not more than 3in. in length, ascending rivers near their confluence with the sea.' The existence of this bar in the Waikato must surely also affect the other species of fish found in Taupo Lake, and will thus enable us to distinguish the fishes that do not require to visit the salt water."

Captain Mair, however, has something to say about eels ascending falls in rivers, which may be inserted here, although perhaps in not the most appropriate place. He writes in *The Transactions of the New Zealand Institute*, vol. xii., as follows: "Where the Ohura River joins the Wanganui, there is a fall of almost 36ft. In December and January millions of small eels, from 2in. to 5in. in length, and the thickness of a steel knitting needle, may be seen crawling up the face of the overhanging rock whenever there is sufficient moisture. At the time of my visit (February 27th) the season was over, yet I caught a great many between nine and ten o'clock at night by brushing them into a net with a wisp of fern. It was most interesting to see these little creatures wriggling up the fall in solid masses, apparently hanging on to each other; for, if you swept away two or three at the head of the column, the remainder all fall back into the water. Tunariki are considered a great delicacy by the Natives, who have funnels, shaped like a dunce's cap, made of flax, over the falls, into which these little creatures creep till they are quite full, when they are emptied into baskets. Two or three hundredweight are frequently caught in one night in this manner."

In England and other places the young fry are called elvers, and artificial ladders, formed of hay and straw loosely twisted into bands, are arranged to enable the elvers to climb over weirs and other obstructions which would prevent their progress up the streams. The descent of the adult eels, Mr. Kent says, to the spawning beds takes place also in shoals, and the period of their migration, by known signs, may be calculated to within a few hours.

The eel entered largely into Maori diet, and the numbers collected and eaten at gatherings of the tribes seem almost incredible. One instance must suffice. At a feast given by Te Waharoa, the father of William Thompson, to the people of Tauranga, the following inventory of the food was, according to Mr. Colenso, taken down by a credible eye-witness: "Upwards of 20,000 dried eels; several tons of sea fish, principally young sharks; a large quantity of hogs; 19 calabashes of shark oil; 6 albatrosses; and baskets of potatoes, sweet and common, without number.

Captain Mair, from whom I have previously quoted, says: "The eel most prized by the Natives is called tunaheke. The name implies that it comes from the sources of the rivers, and goes to the sea. It is a very fine fish, varying from 1lb. to 10lb. in weight; is bluish-black, with flat head, very small mouth and teeth, tail wide in proportion to the body; but the most remarkable features are its large, deep-blue eyes. It is very strong and active, and can jump out of a canoe. The Natives keep them in large wicker-work baskets placed in the small streams for many months, feeding them upon boiled potatoes, which keep them in good condition. These fish are supposed to come out of the swamps during heavy floods. They are never caught except during rains, and do not readily take bait."

There was another eel besides that described by Captain Mair, which was kept and fed by the Natives to be at hand, and within reach, as it were, when wanted for food or feasts. It was called the kokopu, and found only in the deep waters of slow-running streams. It was and is the largest kind of eel known in New Zealand rivers, living in logs, among rocks, or in holes in the river banks. It is of a chocolate-brown colour, and attains a weight of 70lb. It is generally caught by bait, but sometimes in the hinaki.

At Ola Letie the chiefs are said to have pet eels, which come to the surface of the water at the familiar whistle; and in the extravagant fish days in Rome, when a single dish of fish would cost from £100 to £1,000, pet eels were fed with human slaves. It is worthy of notice, however, as Mr. Phil. Robinson points out: "That in spite of the intolerable affectations of Roman connoisseurs as to the niceties of flavour between this fish that had been caught on one side of a river and that which had been caught on the other, they all drenched their subtle-flavoured dishes with halec, garum, and other sauces, which were so strong and composite that it would have been hardly possible to distinguish a fresh fish from a putrified cat, except by the bones."

There are many varieties of eels according to Maori nomenclature. The puhi, the most prized of any, which it is said will not go even into brackish water; the kapo, or blind eel, found in perfection about Rangitoto, almost too fat to cook; the whitiki, with the small head, never found in running creeks, but in swamps or sluggish streams, and which is generally too fat to dry in the sun; the migratory heke, a stranger apparently wherever found; the taringapokipoki, black and large, found in the rapid rivers, fond of whitebait as a Greenwich epicure; the coarse, dirty-brown ngeangea, with its long, thin, flat tail; and perhaps several others in different parts of the Colony, were Maori experts questioned on

a subject to them both intimate and interesting. And the subject is one worthy of enquiry, as eels cost nothing to cultivate, and are one of the richest and most nutritious forms of food possible to find, and of which we know scarcely even the periods of their migrations.

GRAYLING (*Prototroctes oxyrhynchus*).

Length six and three-fifths that of the head, or five times the height of the body; snout conical; lower jaw shorter.

Reddish brown, paler below, sometimes speckled with grey on the back; variable in colour.

Called by the Natives upokororo. A dainty little fish, said to be first cousin, at least, to the English grayling. It possesses the same shape, colour, and fins; and, in the Australian waters, the identical peculiarity in its cucumber smell, which is here so observable in the smelt. Usual size under 1lb. in weight, and from 10in. to 12in. in length. Dr. Hector says: "It appears to inhabit clear running streams in all parts of the Colony, and I believe that the very large fish, locally called trout, which are sometimes cast up on the beaches of the great inland lakes of Otago, also belong to this species. These probably reach 6lb. or 8lb. weight. The upokororo is readily recognised from the smelt (which is the only other fish in our streams with a fleshy second dorsal) by its small tumid mouth, shorter lower jaw, and minute teeth, closely packed together, like a comb, round the jaw. They vary very much in richness of colour, from a general silvery hue and brownish on the back, while others are dark speckled brown on back, and rich yellow, almost golden tint, on the belly." It was at one time considered a sea-going fish that enters the rivers for spawning, but further observation has proved that they are constantly resident in fresh waters, and that the annual migration does not extend beyond brackish water. They do not rise readily to the fly, but they take a certain worm got in farm-yards greedily. It is found in clear running streams in all parts of the Colony, and in some months in shoals, "intent on making up stream."

Mr. Hursthouse, of Taranaki, writes: "The upokororo, which you describe as a sea-visiting fish, is not such here. I made its esteemed acquaintance years ago in our little *belle viviere* Waiwaikaiho. Natives, however, told us that it is solely an inhabitant of fresh water, that it spawns high up the streams, and that, though always present in the pools along their courses, they come down in great numbers during floods. The only one ever found

here in salt water was a dead one, picked up at the mouth of the Henui, after a heavy spate. Our most skilful brother of the rod, Mr. H. Smith, who, as shown by his diary, caught last year 1,152 of these fish in fifty-eight fishing days, taking in one day ninety-three, thinks that upokororo would no more voluntarily get into salt water than into hot water. Here, with our rude tackle, they do not rise at the artificial fly, but greedily bite at the small red worm which is only found under dry stock droppings. The common garden worm has never tempted them."

Mr. Rutland, in his paper on "The Habits of the New Zealand Grayling," in *The Transactions of the New Zealand Institute*, vol. x., pp. 250-252. gives the following interesting information respecting its habits:—

"My attention was first directed to the grayling in 1853. Being then resident in the Waimea (Nelson), I was informed that during the winter months large numbers of these fish came into a small brook which ran close to my house. This brook, about 30ft. wide, emptied itself into the Waiti, a tributary of the Waimea River. Except where it passed through large swamps in the bush, it consisted of a series of deep pools and shallow rapids, and was everywhere overshadowed either by the forest trees or with flax and veronica bushes. In June I saw the first grayling; they came in shoals evidently intent on making up stream—a mixed lot of fish, the smallest from 6in. to 7in., the largest about 12in. in length. A mill-dam, a little higher up than where I lived, prevented their progress for some days, and gave me an opportunity of capturing a great many.

"I noticed that both the large and small fish contained roe, and that they had a peculiar habit of congregating in the deep water, packing themselves close together near the bottom. When disturbed they scattered, but, in a few minutes, again collected on the exact spot from whence they had moved. In July or August I saw a few straggling fish, apparently making down stream, but I failed to get any at that time.

"On two occasions during autumn I saw grayling in the larger rivers of the Waimea; once in the Waiti, near its junction with the Waimea, and once in an overflow of the latter about 2 miles from the sea. On both occasions the fish were in shoals, but swimming apart, not huddled together as in the brook.

"Now turning to the Wairau River (Marlborough), which is in every way similar to the Waimea River, except in being larger and draining a much less wooded country, I find the grayling here with precisely the same habits. From the Onomorutu, a small bush tributary, where during the winter months cart-loads of these fish were formerly taken, I have collected information. The appearing and disappearing at the same time of the year, the

crowding together at the bottom of deep, shady pools, and the bulk of the fish being full of roe, correspond with my own observations in the Waimea. From this I think we may safely conclude that in this portion of the island the grayling, during the winter, leaves the large open rivers and enters the small sheltered streams for the purpose of spawning. But from whence do they come to reach those streams? From the sea, or the upper waters of the large rivers? From the Maitai river (Nelson) I have collected information which I think may answer the question.

"Mr. G. Smith, who resides on the banks of that stream, 5 miles out of Nelson, informs me that the grayling make their appearance in February, always coming up the river in shoals. They remain till the middle or end of winter, and then entirely disappear. During the last three years they have become very scarce, which he attributes to the introduction of the trout.

"Mr. Norgrove, who formerly resided in Nelson, thus writes: 'I have taken the grayling in the Maitai, just where the tide breaks into the fresh water, in large quantities, and as much as 4 miles higher up, always in shoals. About the month of March they go up to spawn. I have fished at the mouth of the same river at all seasons in the salt water, and caught lots of so-called herrings, which are, I believe, a kind of mullet, but never caught a single grayling at any time. They remain about a month, and then not one to be seen higher or lower.'

"Notwithstanding this negative evidence obtained from Mr. Norgrove, I am still inclined to think that the grayling does resort to the sea. When I consider the small size and nature of the Maitai River, I cannot otherwise account for their disappearance during a portion of the year. From its source in Landtrap Gully to its mouth is a straight line for from 7 to 8 miles, running over a rocky floor the greater portion of that distance. How could immense numbers of fish, such as were formerly found, conceal themselves, and, again, where are the small fish? No one seems ever to have seen grayling less than 6in. in length, nor have the large fish been seen except in shoals."

A specimen was found dead on the Mataura River bank, at Gore, in 1884, and as the fish is not common in Otago waters, Mr. Arthur considered the find of interest. Gore is about 35 miles from the sea. Mr. Arthur thinks the evidence conclusive that during a portion of the year the grayling is a resident in salt water. From a report by Mr. A. K. Smith, a grayling was probably taken in the sea at Otago Heads, off the North Spit, in September of the same year.

KOKOPU (*Galaxias fasciatus*).

Length four and a half-times that of the head, which is rather more than the height of the body; diameter of the eye about one-fifth of the length of the head, and shorter than the snout; length of the pectoral more than one-half the distance of its root from the ventrals, and the ventral terminates at a short distance from the vent; the least depth of the tail equal to or less than the distance between the dorsal and caudal fins.

Blackish or reddish brown, with undulated, more or less irregular, light-coloured cross bars.

Attains a length of 7½in.

"Kokopu," Dr. Hector says, "is the general Maori name for several very common fishes in the New Zealand streams and lakes, belonging to the family of *Galaxidæ*. *Galaxias fasciatus*, the kokopu proper, is a fat, sluggish fish, found lurking under stones and rotten logs in all the streams in the colonies, however small, where not running over a clear or stony bottom. They afford very tame sport, but are fair eating, resembling the eel in flavour."

The Natives give the fish a larger size than Dr. Hector, saying that it grows up to 9in. in length, and does not exceed 1lb. in weight; but they say there is the kokopu of the stream and the kokopu of the lake, which are quite distinct from each other. The kokopu of the stream is caught by them with bobs; but is not much cared for. Not more, as a rule, than one or two fish will be found in a pool; half a dozen at the most. It is also called rawaru and para.

The kokopu of the lake resembles, they say, the rock-cod, but it does not exceed 5in. in length. It is found in Taupo, Rotorua, and at Tarawera. The kokopu of the stream has no scales, whereas the kokopu of the lake is scaly like the kokopu of the sea, and resembles it in almost every respect. It is caught by the Natives in Taupo in great quantities in nets, and considered by them a great delicacy; strung by them on flax strands and dried in the sun, when it is kept sometimes for years.

"The general name given to all the species of *galaxias* is trout, more, I should think," writes Mr. Macleay, "from their spotted appearance than from any actual resemblance; but, like the trout, they are good for the table. The species are numerous, but so much alike that it is—looking at their distribution—more than probable that they are one and all permanent local varieties of the same fish. But the chief interest attached to these fishes is in their distribution. They are found only in the rivers of Southern Chili, Magellan Straits, the Falkland Islands, Tasmania, New Zealand, and those parts of Australia where the rivers take

their rise in the Snowy Mountains, or in cold, elevated table lands; so that, in fact, we find this singular fish in all the lands which extend into the colder regions of the Southern Pacific, and nowhere else. The deduction from this singular fact is very plain. At one period—probably very remote, even in a geological sense—the area of land above the sea in the antarctic regions must have been very much in excess of what it is at present; at all events, sufficiently extended to admit of some kind of continuity across the whole width of the Pacific, between the southern extremity of South America and Australia. There is no other way of accounting for the appearance of these fishes in such widely different localities."

KURAHINA (*Eleotris radiata*).

Length three times that of the head, or six times the height of the body; interorbital space flat; scales moderate, minutely citrated; snout moderate; head depressed, the breadth being rather greater than the height.

Colour (in spirits), pale yellowish-red, with several vertical brown bands on the caudal.

Not uncommon at the Thames, Captain Hutton says; and adds that Valenciennes gives the following description of the colours of the specimen taken by Quoy: "Reddish, with twelve vertical brownish bands on each side; fins, whitish; the first dorsal with two longitudinal black bands, the upper large and dentate; the second dorsal with three less marked; the anal with one: the caudal with many vertical brown lines; at the base of the pectorals a blackish straight line."

SMELT (*Retropinna Richardsoni*).

Length four and a-half times that of the head, or five and one-third times the height of the body; snout longer than the diameter of the eye in the adult, but shorter in immature specimens; mouth, moderate; maxillary extending to behind the centre of the eye, posterior and enlarged and curved downwards; lower jaw longer; ventrals situated rather before the middle of the body.

Above, pale grey; below, white; a silvery band along the sides.

Common in rivers and lakes. In the Waikato they go down to the sea to spawn in April, and the young fish return in October, when, together with the young of *Galaxias attenuatus*, they are called whitebait.

Dr. Hector writes: "This delicate little fish, which belongs to the true *Salmonidæ*, was first described by Richardson, from specimens which were obtained at the Bay of Islands with a net, and, therefore, I infer in the salt water, but it is at certain seasons one of the most common of our fresh-water fishes. My first acquaintance with these fish was in 1863, at the mouth of the Kaduka River, on the west coast of Otago, where, in the month of September, both kinds were obtained, the larger variety (*R. osmeroides*) following the flood-tide in numerous shoals into all the little streams to which the brackish water penetrated, leaping out of the water in a very lively fashion—the Macris catching them as the tide fell by closing weirs made of flax net across the small creeks. Their length was from 4in. to 7in., and they took bait voraciously. The smaller fish (*R. Richardsoni*), averaging 2in. in length, on the other hand, chiefly appeared round the sides of the vessel in swarms at ebb-tide, when the water was quite fresh, and were caught with bag nets. Later in the season, during the month of November, the same fish was found in quantities in the Kakapo Lake, where the water is always quite fresh; but along with the smaller ones were many of larger size, averaging 4in. in length, and having the appearance of adult fish, without showing any of the characters of the larger form. In the Blackwater, which is a tributary of the Buller River, 20 miles from the sea, I am informed that a fish which answers to *R. osmeroides* is abundant from February till June, and is caught in large quantities with a net at night-fall, but that the smaller fish, which was described to me as the whitebait with a silver line on the sides, arrives in October in closely-packed shoals that advance steadily upstream against the rapids. Captain Hutton states that in the Waikato these fish go down to the sea to spawn in April, and that the young fish return again in October, but among the specimens he collected both forms can be distinguished, although some specimens of each are of equal size. In a collection of fishes obtained from Taupo Lake I also find a small-sized form of the smelt, which, though differing in some respects from those found in the Waikato, has decidedly the characters of *R. osmeroides*. Specimens caught 16 miles up the Wanganui River in the month of November also have the characters of *R. osmeroides*. They are 5in. in length, and full of roe. Both the large and the small smelts form delicious food, the smallest size, when about 2in. in length, being one of several young fish that are called whitebait. The large specimens, 7in. in length, were called aua by the Natives, which is also one name for the small sea-mullet."

Retropinna Richardsoni is found in Tasmania in various estuaries at certain periods of the year, and is caught in myriads in the shrimp nets. It does not exceed, Mr. Johnston says, 3in. or 4in. in length. Mr. H. Travers brought specimens from the Chatham Islands.

WHITEBAIT, OR MINNOW (*Galaxias attenuatus*).

Length five to five and a-half times that of the head, or eight to ten times the height of the body; diameter of the eye one-fifth of the length of the head, equal, or nearly equal to the snout; length of the pectoral one-third of the distance of its root from the ventral, and the ventral only one-third of its distance from the anal; the least depth of the tail is not quite one-half the distance between the dorsal and caudal fins.

Greenish yellow, more or less spotted with brown, each spot being composed of minute dots; top of the head generally darker than the rest of the body; operculum, silvery.

Very variable, especially in the shape of the snout, the prominence of the eyes, and in the colour, being sometimes almost without spots, and sometimes largely blotched on the back and sides with dark brown.

Abundant at Waikato, Lake Taupo, River Avon, Chatham Islands.

Attains a total length of 4½in. to 5in.

In the Waikato these fish go down to the sea to spawn in April or May, and the young return in September, October, and November, when, together with the young of *Retropinna Richardsoni*, they are called whitebait.

In this manner is the little fish described by Captain Hutton, of which Dr. Hector writes: It is a little fish, constantly seen in most lakes and clear running streams, with very much the same habits as the English minnow. At certain seasons the young fry swarms in incredible numbers, and forms the whitebait of New Zealand, but is a very poor substitute for the little herring that is so well known at Greenwich by that name. At Taupo Lake and other places in the interior, small fish, which the Maoris collectively term inanga, but which are chiefly of the species now referred to, form the food of the Natives for many months in the year, and are obtained in such abundance as to yield an ample supply both for daily use and to preserve for other seasons. These small fish are caught where streams enter the lake, with fine-meshed nets woven of green flax. Several bushels of them are frequently caught at one time, and are immediately piled on hot stones and covered with mats and earth for half-an-hour or so, in the usual manner of Maori cookery, but without the addition of any water. Thus prepared, if not for immediate use, they are firmly packed in tightly plaited baskets, and in this state will keep for months—at least sufficiently well to suit the Maori taste, which is not fastidious.

Only a short time since, in England, the whitebait was supposed to be a distinct species of the herring family, and less than sixty years ago naturalists would not admit that it was the young of the sprat and herring. Now, the early belief is held to be untenable, and there, as well as here, the whitebait is regarded as the young of other fish.

The following details have been obtained from Native and other sources, but they lack the stamp of recognised accurate observation; and are here given to provoke, or to stimulate inquiry :—

Inanga, Captain Mair writes, are plentiful in the upper Wanganui River. A large kind called atutahi are most esteemed as food. They are almost 5in. in length, and quite transparent. Dr. Hector says that several small kinds of fish at Taupo are collectively called inanga, the chief season for them being from October to January; but as late as March all sizes can be found.

The Natives say the inanga is found generally in the lakes and streams of the North Island; save in the Waikato district, where they are unknown. They are found in quantities in the streams in the Bay of Plenty district, some 2in. or 2½in. in length—a rich, delicate fish, like the whitebait at Mercer, but not so long; without scales. In all the waters about Taupo, and said by some to be fatter as they are found further south. They are caught in large quantities by the Natives, cooked for some hours, and packed in baskets, and put away in store to regale visitors. If the flies are troublesome, the baskets are put into running water for preservation.

The koara is a small spotted fish from 1½in. to 2½in. in length, found only in Lake Rotoaira, south of Taupo. It is said by the Natives to resemble the koara of the sea in shape, which ranges from 1½lb. to 2lb. in weight; a small facsimile in fact. Scaly. Caught in nets in large quantities; dried and kept for food.

The mohi are found in the mountain and fast-running streams in the Waikato. They are caught from July to December, when they go to the Waikato River or seaward to spawn. They are 4in. or 5in. in length, with dark back and silver belly. They are called mohi from their resemblance to the mohi of the sea, found at the Thames. When the mohi goes seaward it gets caught in the weirs, as many as 70lb. having been got in a single catch. The Natives say the whitebait is the spawn of the mohi, which may be the Maori name for the smelt. The Maori name for whitebait is porohe.

There are two other small fresh-water fish, the parikou and the karengorengo, but little information is at hand concerning their form or their habits.

The papanoko is thus described by Captain Mair: "Small fish from 6in. to 8in. in length, and very deep in proportion, weighing about the eighth of a pound. At this season of the year (January) they are very fat, full of spawn, and are most delicious eating. The fins are red; scales very small; back, pepper-and-salt colour; belly, silvery. This fish is called *te ika huna a Tane ma huta*—the hidden fish of Tane (the god of the forests)—for they are never found in the streams or rivers unless during a flood, and then only during the night. Great ceremony is observed in cooking them, and they are taken some distance from the village for the purpose."

The toitoi is described by Captain Mair as a small blue fish, similar to those caught in lakes, but larger. They are fair eating, but full of bones—quite unlike the papanoko, which have hardly any.

The Natives say there is a salt-water toitoi as well, which the fresh-water toitoi resembles. The fresh-water fish has scales varying in colour from black to brown. Its length varies from 4in. to 7in. In shape it is not unlike the gurnard, with a tail resembling the schnapper. It is found in Taupo in large quantities. It is caught with nets. Though dried, as the kokopu, it is not considered so good a fish.

FISH CANNING AND FISH CURING.

A good deal of information concerning the curing and preservation of fish for mercantile purposes will be found scattered through the notes on marine fishes in the first section of the handbook, but there are many other details which will be more appropriately glanced at in a separate manner. The subject is a wide one, and its particulars are not easily got at. "Fish," it has been said by Mr. Day, "may be either dried, either in part or wholly, or pounded and then dried in the sun, shade, or by artificial means; or smoked wholly or partially, salting or drying being used or abstained from; or salted, either dry or in pickle, in various ways, while sugar may be employed in the place of salt; or preserved by the exclusion of air or with the assistance of acids; or by keeping the fish by means of natural or artificial cold at a temperature below that at which fermentation or decay sets in." Of so many processes there is little hope of obtaining full information unless the subject were carefully investigated. As "The Fisheries Encouragement Act, 1885," gave the premier place to the canning of fish, what can be gleaned on the subject may be first stated, remembering that the details connected with "canning," as it is called in America, are generally kept as trade secrets, and not frequently found in print. The main portion of the following particulars is taken from the evidence of Messrs. Hugh Logan and Rice Williams before the New South Wales Fishery Inquiry Commission, supplemented from information communicated by a colonial expert. When expedient the evidence of the witnesses will be given in their own words.

Mr Logan, who stated he had made some of the first experiments in tinning salmon in California, said: "The process was to cut the fish up with a number of curved knives—say seven or eight—with a lever attached. The fish are laid on a bench, and the lever being pulled down the knives cut the fish into sections the size of the tin, whether 1lb., or 2lb., or 4lb. Then the fish are put into the tin, and a small teaspoonful of salt is added to each can to take away any unnatural flavour. The cans are then put into a large boiler and heated with steam, and after the fish have boiled a certain time, say twenty minutes, under the greatest heat they can get—the steam is 210°, but there they get the heat up to 280° by the addition of chemicals.

"After the fish are cooked a certain time—some thirty minutes—the screen that the cans are on is raised out of the boiler and a man goes round them with a little mallet, having a small spike on it, and he taps every one of the cans, by which means the gas that has accumulated in the cans escapes. After the fish have settled down, he solders the small hole, lowers the screen with the cans again into the boiler, and the water is raised to the boiling point, so as to produce steam inside the cans. When they are taken out and cooled, the steam condensing produces a vacuum in each can, and the cans are then put into a place where they are left for one, two, or three days to see that they are perfectly tight."

Mr. Logan's evidence may want perhaps a little amplification to make it plain to the general reader. Let him imagine, then, an iron tank—say 4ft. or 5ft. square, and some 2ft. in height—open at the top, and he will have a picture, in his mind, of the form of the boiler in which the canned fish are cooked. The iron tank has a false bottom, separating the tank or boiler into two horizontal compartments. The lower compartment is used for the production of heat by means of steam pipes, connected with a steam boiler, which pipes, somewhat in the form of a worm, are spread over the main bottom of the tank. Steam is turned on or let off by means of taps or cocks in the steam pipes. There are two inlets and two outlets to what may be called the heating chamber of the tank. Thus the boiler, which generates the steam, may be on one floor, or in one building, and the tanks or boilers which cook the fish on another floor, or in another building. The false bottom serves as a floor on which the cans rest when put into the tanks to be cooked. In the tanks which cook the fish is the liquid which cooks them—not unlike brown boarding-house soup, both in appearance and consistency. This liquid reaches to within some half-an-inch of the top of the cans which contain the fish or meat that is being cooked. No bubble is seen on or steam evaporating from its surface. The water being brought to boiling point, chloride of calcium is added to it, in which it quickly dissolves. The chloride is employed because its solution can be maintained at a heat of 270° to 280° Fahr. without material evaporation.

Here the evidence of Mr. Rice Williams, described as a chemist and druggist, appears valuable. He says: "The secret of fish preservation is to increase the boiling-point from 212° to 240°, or a greater heat, which is done by saturation. The difference in the heat must be taken from the time it would occupy in ordinary cooking at a heat of 212°. The water should be saturated with salt or any soluble matter, such as alkalies, sodas, or even sea-water, sufficiently condensed to saturation. The extreme heat is further enhanced by placing layers of hay or

straw between each tier of the tinned fish. In packing for the bath or in packing in the boiler, the hay or straw should be laid between each tier." Being further examined on this matter, he said: "The great secret in boiling fish or other food, in order to preserve it, is to raise the heat higher than 212°, and to exhaust every particle of air from the vessel. . . . The more the water is saturated or condensed the greater are its preservative powers. . . . If you cook fish it will not keep three days if boiled at 212°. The best heat for cooking fish, it appears, is 240°. At all events, this is quite enough, although the liquid in the tanks can be raised to 280°. If 240° is exceeded the tins will burst. The fish are cooked by two boilings, the first taking thirty minutes for efficacy."

After the small holes in the tins are soldered up, they are again placed in the cooking tank, the heat of the liquid not being allowed to exceed 220°. The time for the second boiling is forty-five minutes. Care has to be taken that the temperature does not exceed 220°, or the cans will burst. The tins are then, after their second cooking, lifted out of the tank and placed in a cold bath, if one is at hand, and allowed to remain four or five days to test their condition before being sent away, when, if aught is wrong, the fault will appear outside the tin. A bad tin bulges from the generation of gas within, while the tin well cooked becomes compressed. When the tins are pricked they should be stopped as soon as possible, the object of the pricking being to allow the gas generated by the cooking to escape. If the air gets in to the fish the contents of the can is spoiled.

In a vat 4ft. 6in. × 5ft., a man and a boy accustomed to the work can cook 1,000 tins a day; the vat cooking say 200 tins at a time. When the liquid is cold in which the cans are heated, the chloride settles at the bottom of the tank. The chloride is purchased in drums containing some 5cwt., a drum lasting a considerable time. The process, it will be seen, is simple, and, in the matter of cost, comparatively inexpensive.

The older process was the use of a wooden bath and pure water, the tank being covered. As the temperature was less the time of cooking was longer. The process was almost the same as that already described, but, as it has fallen as it were into desuetude, amplification may be regarded as unnecessary. The times of cooking were for the first portion one hour and forty minutes; for the second, one hour and thirty-five minutes.

In the *Encyclopædia Britannica* the process is similarly described: "The tins used are manufactured with the greatest care, and most ingenious machinery has been devised for their thorough and expeditious preparation. The proper quantity . . . of fish is placed raw in the tin, over which the cover

is then soldered. In the cover a small 'pin-hole' is left, and the tins are placed in a bath or solution of chloride of calcium, which boils at a temperature of from 260° to 270° Fahr. Each tin is immersed to within an inch or two of the top, and as the heat is gradually raised, steam issues from the pin-hole, carrying off the atmospheric air from within the tin. When all the air has been expelled, the pin-hole is promptly closed with a drop of solder, and the tin, hermetically sealed, is entirely immersed for some time in the super-heated solution. When withdrawn and cooled the tins are placed in a testing-house, in which, after a few days, those that have been imperfectly treated manifest their defects by a bulging of the sides, due to the generation of gas from the putrefying mass they contain. Those which have been successfully preserved generally show both ends collapsed or depressed by the pressure of the air outside; and usually on a well-preserved tin being opened the air is audibly sucked in."

The preservation of sardines, as is well known, is due partly to cooking them in oil and surrounding them with it, and partly by sealing them in tins.

The more recent and improved plan of cooking is in retorts made of cast-iron, fitted with dome-like covers. A block and tackle, or other machinery, is used for lifting the cover from the retort, or lowering it down in its place. The cover, of course, is screwed on with the common bolt and nut, and packed in the usual manner with ordinary packing. The retort is fitted with a steam gauge to register the heat that is found best adapted for cooking the particular commodity under treatment. In this plan there is no use of muriate of lime or other appliance necessary beside the retort itself, and not only is the time of cooking shorter, but the process is more expeditious. The *modus operandi* may be said to be the same—cooking it twice, pricking the tins, and soldering, as in the bath; the time of cooking in the retort being forty minutes at both stages. The heat is kept to about 240°. Perforated trays of sheet-iron, which are filled with cans of fish, are made to fit the retort. Tray is placed above tray until the retort is full, when the cover is lowered down and screwed on, and the cooking begins. The trays, having chains attached, are lifted out with a block and tackle, which is necessary for the lifting and the lowering of the dome-like cover of the retort. As the chemical plan, with the iron tanks, was an improvement on the water-boiling and the use of wooden vats, so is the retort process one equally superior to the use of chemical means of increasing the temperature of water, as previously described.

There are some incidental matters given in the evidence which need insertion. Mr. Logan said: "The fish were scaled and cleaned in the usual way before being cut up and put into

the tins. The labour employed in California was mainly Chinese. The fish are canned as soon after being caught as possible. The boats," he said, "go out and remain two or three hours; they then come in loaded, and go right into the works, and that day every fish is canned." He added: "The canners never keep any over night." If fish are kept too long they go bad, as though the cans were imperfectly soldered.

Mr. Williams tells us that the tins should be packed as closely as possible, because the cooking causes the fish to "collapse." "The lid is put on in two parts," he states, "and, when the larger part or ring of the lid is put on, the tin should be filled up with clean water if it is not intended to have the fish salt—filled up as full as possible. Then the balance of the lid, which is of the size of a shilling or half-a-crown, is soldered on. The tins," he adds, "*should be painted while boiling hot.*"

Processes for the exclusion of air by the substitution of an atmosphere of some inert gas have not proved successful; neither has the method patented by Dr. Redwood, which consisted in coating meat with a layer of paraffine.

There are other opinions held about fish-canning than those given in the preceding pages. Thus a writer in an American periodical only a short time since wrote as follows:—

"I hold that if a can is once properly sealed, the contents will remain unaltered as long as the metal casing remains intact. A can will keep, if every portion of its contents has been subjected to a temperature of 212° Fahr., whether the air is expelled or not, as my experiments have conclusively proved. When I first began the business I was taught that the air, unless expelled, would cause the contents to deteriorate, and that was the reason the cans were vented. I soon found that it was a mistake. The venting is done for the purpose of testing for leaks. A tight can has a sound that cannot be mistaken for a leaky one. If the canner boils his fish, flesh, or fowl when the vents are open, he will have dry cans for his pains."

An invention was recently patented by Mr. M. C. Hutchings, of Astoria, Oregon, to test sealed cans, for the purpose of detecting leaky ones in time; to seal them and prevent the contents from becoming decomposed. A cylindrical iron or steel vessel placed horizontally is provided, at one end, with a hinged door, which may be held closed hermetically. The cans to be tested are placed on the truck running on a track laid within the vessel. The cylinder is furnished with a pressure gauge and safety-valve, and it is connected with a pump for filling the vessel with air under pressure. After remaining in the vessel for several minutes the compressed air is allowed to escape suddenly. The air has time to find its way into all cans which are not soldered perfectly tight,

so that an equilibrium of pressure is maintained outside and inside; but with the sudden relief of exterior pressure, the air within the defective cans fails to find ready exit, owing to the small size of the openings in them, and hence exerts a strong outward pressure, thereby bulging one or both heads. The bulged cans can easily be assorted from the rest, and are then soldered and again tested. By this means great losses in material and freight are avoided.

Of the canning of fish at Kaipara, details will be found under the heading "Kanæ;" while a Government ranger at the other end of the Colony writes of the tinning of fish at Stewart Island in this wise: "This branch of the fishing trade is becoming a reality. Robertson Bros., whom I mentioned as having begun operations at Paterson Inlet, have removed to Horseshoe Bay, a situation supposed to be more convenient for the work they are conducting. Already they have sent away several tons of tinned fish, which is being well spoken of. At Half-moon Bay another party of three men have made a beginning in the same line. As yet they have prepared only about half-a-ton, done up in 1lb. tins, which they offer for sale at 6s. per dozen. It would appear to me that this mode of preparing fish for sale will become a permanent industry at Stewart Island, for it has the advantage of being the only way of making the fish retain their original flavour after the lapse of a few weeks. Even the best smoke-dried fish I have seen become rancid, and have an oily taste after being kept for say a fortnight. This arises from the peculiar nature of the cod, trumpeter, and moki, caught at Stewart Island. Unlike the cod inhabiting the northern seas, which carry their fat in their liver, the fat in the fish here runs all through them, as does the fat in the salmon, and exposure to the sun and to the atmosphere soon turns this fat into a rancid oil." The same writer says: "Curing fish by smoke-drying is gradually being discontinued The only persons I know of as being employed at such work are two families living at Bravo, in Paterson Inlet. They put through their hands about half-a-ton per week."

Smoking is effective in preserving and flavouring fish that is intended to be kept only for a limited time after curing.

How cod-fish are salted is described under the heading "Hapuku." Of the means used for herring-curing, the following information has been obtained from the *Fisheries Literature:* "In the north of Scotland the herrings, on arrival, are placed in a heap near the troughs of the curers; next, they are gutted by individuals who, at one cut, remove the intestines and gills. They are then 'roused' with salt in a tub; and, lastly, packed in layers in barrels, a handful of salt being sprinkled over each layer. As the fish subside a fresh layer is added, as the barrel has to be

kept full. Broken or inferior fish are rejected. After remaining fifteen clear days in the pickle the barrels are filled up and finally closed."

Off the Coast of Montrose, where the herring boats go 70 or 80 miles to sea, it is the custom to carry salt enough to sprinkle over the herrings, and thus save them for four or five days. Herrings thus treated are termed "salted in bulk;" but are not allowed to bear the Government brand, as the regulation for this mark is that the fish should be cured within twenty-four hours of being caught.

Yarmouth bloaters are variously prepared, but one of the best solutions in which this can be effected is by mixing 29lb. of common salt with 71lb. of water, in large vats; in this the herrings will float, so they are kept down by wooden battens weighted with bags of salt which gradually dissolve and keep the solution at its proper density. When the fish have become rigid the pickle is run off, and the herrings are suspended in a current of air until they are removed to a chimney and smoked from twelve to eighteen hours, the fuel employed being two parts each of oak wood, beech wood, and turf. These bloaters will keep four or five days, but are best if hanging in a current of air.

Red herrings are bloaters more slowly cured, the pickle having about 1-16th of its weight of saltpetre added to the salt. They are dried for twenty-four to forty-eight hours, and then smoked the requisite time.

Kippered herrings are such as are pickled, dried, and split down the back almost to the tail fin, showing the back bone; the gills and intestines are removed; they are then cleaned with salt and water and suspended for a night in a current of air, and then smoked until they are of a light brown colour. They do not keep long.

Mr. George Leach, of Hull, has introduced a plan of curing herrings by machinery, and estimates a barrel of herrings can be bloated at a cost of 6d. as against 1s. 9d., the ordinary charge. The plan may be described as a successive process of drying, smoking, and cooling, by carriage from the cleaning room to the grills on wire-work trays. By passing up through a series of chambers and down again in a zig-zag direction, they are operated upon by the agency of heat, smoke, and cold, and on their coming down to the reception table at the end of the first journey they are ready for packing.

The Dutch are famed for the scrupulous care in every incident connected with their fishing and curing operations. They have two kinds of fish and two kinds of salt; this latter commodity is brought from Spain. The barrels must be of a

certain kind, the mode of eviscerating must be kept up to the standard, and from beginning to end every detail must be complied with. Mr. DeGroot Pzn gave some interesting details on fish-curing to the New South Wales Fisheries Inquiry Commission. For instance, he says: "The herrings in Scotland are dead when they are cured, and in Holland they are living. When you open a well-cured Dutch herring the bones are quite on the flesh; when you open a Scottish herring the bones lie quite along in a good condition. The Scottish herrings are only good to eat when they are fresh—when cured fourteen days—but they cannot stand preserving very long without losing their flavour; the Dutch herrings the longer they are preserved the better they are."

What he says about the curing of stokvisch and zoutevisch is both amusing and suggestive. He says: "The cod is fished, caught, and opened. They cut him in two parts, take out the head part, and cure him. That we call zoutevisch, and is an article of great export. The stokvisch and the salt fish are the same fish. The stokvisch come from Norway, and are dried on the rocks near the sea, where, every time the water gets high and the waves are heavy, it makes them wet. It seems to cure them very well. They get very hard—hard as wood—and they are packed in big bundles and sent all over the earth, except to Australia."

The Maori at the other side of the world used to cure their fish by dipping them a great many times into salt water and then drying them in the sun. Rutherford wrote: "The large mussels they bake in the usual manner, and then taking them out of the shell, string them together and hang them up over the fire to dry in the smoke. Thus prepared they eat like old cheese, and will keep for years." Preservation by simple drying is common among the Chinese for such foods as trepan, dried tendons, skins, fish, mussels, and other molluscs.

The use of antiseptics for the preservation of fish has been long known, and some years since a company was formed in London to put the knowledge to mercantile use; but it ended in failure, though the directors wanted £1,000 for the disclosure of the receipt, which formed, as it were, the stock-in-trade of the Company. But the Norwegians use a chemical powder for the preservation of herrings in a fresh state, the constituents of which are well known, there being no mystery made on the subject. That the process of curing has been successful is clear from the following details: In the winter of 1884-5 not less than 20,000 barrels had been disposed of in the English market, realising as much as 28s. per barrel. But the fact that some 5,000 barrels of these Norwegian herrings had been imported into Scotland, beating the Scotch herrings on their own ground, not only awakened curiosity, but provoked inquiry; and this the more

especially when the *Weekly Scotsman*, of 30th January of this year, said: "Herrings pickled on the 19th January are as fresh and sweet to-day as when they were introduced into the mixture, and when cooked they can scarcely be distinguished from herrings only a few hours out of the water." It then came out that herrings caught on the coast of Norway can be barrelled, sent round the east, north, and west coast of Scotland, and sold in the port of Glasgow fresher than those transported by rail from Wick, Peterhead, or Aberdeen; hence the higher price realised. This is done by the use of the chemical powder mentioned above, which is a simple mixture of boracic acid and common salt, which high authorities in antiseptics declare has been utilised in Scandinavia for the preservation of food, such as flesh, etc., for the last fifteen years. It will keep articles fresh, they say, for several weeks. The mode of application to the herrings is very simple. 1lb. of powdered boracic acid is mixed with 2lb. of fine salt; the fresh fish is laid in layers in a barrel, and each tier covered with a thin layer of the mixture. When the barrel is full it should be tightened down in the ordinary way, and then pickled with a weak solution of pure boracic acid. It has been found that for a barrel of herrings 2½lb. of acid and 5lb. of salt are required, while about 10oz. of pure acid are needed for the pickling solution. The barrels when packed should be kept in a cool place, an equable temperature being desirable. Boracic acid can be purchased in England for less than 6d. a lb. It should, however, be stated that boracic acid, in repeated small doses, exercises a specific influence on the excretory organs which is said to be injurious to health.

There are three indispensable conditions, we are told, to enable putrefaction to ensue—a moderate degree of heat, moisture, and access to the atmosphere. When one or more of these conditions are lacking, putrefaction is arrested. Thus, meat is frozen, or fish packed in barrels of ice for transport. "Putrefaction," says Cohn, "begins as soon as bacteria, even in the smallest numbers, are introduced, and progresses in direct proportion to their multiplication." "And it follows," Mr. Kilbourn adds, "as a logical sequence, that the different conditions between sound fish and rotten ones are but the different stages in the process of putrefaction." Freezing checks all putrefactive action; and though the popular belief is that freezing destroys the flavour of fish, and that they speedily go bad after they have been restored to their normal temperature, the common conviction seems to require correction. Mr. Kilbourn hits the nail on the head when he says: "The flavour of a fish, and its keeping qualities after thawing, depend more upon its *condition* when frozen than upon the deleterious action of the low temperature in which it has been kept. It should be constantly borne in mind that there is *no* restorative power in any system of preservation." A fish that has

been frozen resumes, when thawed, the condition it was in when frozen. Fish for freezing are as for canning. They should be operated on as soon as they are taken out of the water. Dr. Landseer, in his book, *Through Siberia*, says: "There are large fisheries in the Gulfs of Obi and the Taz, where the Russians pay rent for the sandbanks to the Samoyedes, and having caught the fish in summer, they put them in ponds till the approach of winter. They are then taken out and frozen, and in this condition sent as fresh fish a journey of 2,000 miles to St. Petersburgh."

In this way the Russians appear to have solved the whole question. They get the living fish and freeze them, instead of experimenting on fish that have been kept till it is dangerous to keep them longer. It should also be remembered that the main portion of the food of people living in the far north is frozen fish, and that men in the employ of the Hudson Bay Company, especially those on the Makinti River, are fed on frozen fish, and that it is said to be one of the best of diets, though eaten without bread or potatoes. Mr. Wilmot, the Canadian Commissioner at the Fisheries Exhibition, gave, however, very valuable evidence, stating that in Canada fish were caught in June, July, and August, and frozen, and the fish-dealers in New York and Boston would buy them for delivery early next year. It was therefore evident the fish could not be much deteriorated by freezing. He had eaten those fish for several years past, and it was their regular custom to have them on Christmas Day, when, the waters being frozen, fresh fish could not be obtained.

One method of retarding the putrefaction of fish in vogue in Canada appears to be adapted to our New Zealand environments. Mr. Wilmot said: "In Canada, fish were caught in the Great Western Lakes in large quantities. They were put on board of little steam-tugs in refrigerating boxes and conveyed perhaps 100 or 200 miles to the nearest harbour or railway-station. The boxes were then put on the railway-car, and went on, in some instances, 1,000 or 2,000 miles, and were sold as fresh fish, and were eaten as readily as those caught within a few miles of the market. Not only were the fish taken to market, but they remained in the cellars of the dealer for a week or ten days after they arrived there. The process was very simple. The fish were taken out of the water in tons. On deck were a number of boxes, holding about 2 tons. Each box was packed round the outside with non-conducting material. A layer of finely powdered ice was put in the bottom, then a layer of fish, then another layer of ice, and so on until there was fifteen or twenty layers of fish and ice, and it was then shut down tight and sent off. He need hardly say that, if the fish were not in good condition, the inhabitants of the great cities of the United States would not eat them."

There are one or two ordinary precautions which Mr Kilbourn insists on—to wit, absolute cleanliness in every department is of vital importance. "You may as well," he says, "lodge a perfectly healthy person in the bed of a smallpox patient as to pack freshly-caught fish in boxes or compartments contaminated with the filth and slime of previous putrefaction. If any fisherman entertains any doubt upon this point, let him place a row of fish side by side, back upwards, upon a filthy board at the bottom of his boat, and he will find that the bellies of these fish are completely rotten when the sides and back are apparently sound." Again: "The prevailing practice of piling fish *en masse* one upon the other to the depth of several feet is objectionable in every sense, but especially so before the fish are thoroughly cooled; and water could hardly pass through such a pile of fish, much less would it be possible for air to permeate it. When the fish are thoroughly cooled there would be less objection to packing in compact masses; but the bony structure of a fish is not suitable for supporting incumbent weight. Fish, when in a perfectly sound condition, placed in a temperature ranging between 32° and 35°, will remain sound for a long time."

FISH CULTURE.

About forty years since, a labourer in Norway was laid up with a bad leg. Not by any means an uncommon occurrence, it will be said; but this man used to beguile the tedium of his enforced rest by going to the river-side and catching fish. But he did more; he watched the trout spawning, and, assisted by his wife, he secured a pair of fish, and expressed their milt and ova into water. He then placed the fertilized germs in sheltered spots in creeks where trout were not previously found. The eggs hatched, and the fish did well. *This was fish culture.*

"*Public fish culture,*" Professor Goode tells us, "is only useful when conducted upon a gigantic scale — when its statistical columns reach to tens of millions." And he adds, "that to count young fish by the thousand is the task of the private propagator." And this seems evident from the way the matter has been put in a late number of the *Cornhill* magazine, where the writer says: "The fecundity of fish is indeed something incredible. The eggs of soles are extremely small—not so big as a grain of mustard seed —and the roe of a 1lb. fish usually contains as many as 134,000 of them. Turbot are even more surprisingly prolific. Mr. Frank Buckland was acquainted with one whose roe weighed 5lb. 9oz., and contained no less than 14,000,000 and odd eggs. It is a sad reflection that not more than one of these, on an average, ever lives to reach maturity; for, if only two survived in each case, the number of turbot in the sea next year would be double what it is this. The year after that there would be four times as many; the next year, eight times again; and so on, in a regular arithmetical progression. In a very few decades the whole sea would become one living mass of turbot. As a matter of fact, since the number of individuals in any given species remains on the average constant, we may lay it down as a general rule that only two young usually survive to maturity out of all those born or laid by a single pair of parents. All the rest are simply produced in order to provide for the necessary loss in infant mortality. In fish, it generally takes at least a hundred thousand eggs each year to keep up the average of the species."

Mr. Day describes fish culture as comprising several objects, the chief of which are an augmentation in the number, and an improvement in the breed of the fishes of a district, country, or even of the ocean, by means of direct cultivation, not only of the

finny tribes, but also of the food on which they subsist. It likewise embraces whatever facilitates their ascent and descent of rivers, rendered necessary for spawning purposes to continue the race, or for nutriment to maintain the life of the individual. Acclimatization of fishes is the science, on the other hand, of the distribution of the same from one district to another, and the being able to retain life in rivers, lakes, and other waters in which the fish did not previously exist. In New Zealand the two things or processes may be classed together, because our culture of fish has in the main, if not wholly, been directed towards the varieties we have sought to introduce.

There is nothing new in fish culture, unless, perhaps, some hatching appliances. Thirty or thirty-five centuries since a lake was created in Egypt, where the revenue derived from the fishing exceeded a talent a day, and the fish increased so fast that the preparations for salting were insufficient. In the Roman Republic fish culture was carried on for the purpose of augmenting the general food supply. China is stated to be in advance of all other countries in the culture of fresh-water fish, which is one of her oldest industries. In medieval times almost every monastery had its fish pond; while pisciculture with the monks was well understood.

In 1758, a German, named Stephen Ludwig Jacobi, claimed to have rediscovered the plan of fish-breeding that the Reformation had buried. His discovery was considered of so much importance that the British Government gave him a pension. In 1842, the French commenced experimenting. In 1848 their establishment at Huningue came into existence, and their rivers and lakes, by its agency, became restocked by a distribution of 20,000,000 ova annually. The Galway salmon fisheries were artificially restocked in 1854. The establishment of Stormontfield, on the Tay, was commenced in 1853, and Norway, Germany, Italy, Greece, the United States of America, Canada, and the Australasian Colonies have all followed the French example. There has been what may be called a resurrection of a neglected industry in a generation.

In the United States of America, a Fish Commission was appointed in 1871 to investigate the alleged diminution of food fishes along the sea coast and in the lakes; and to suggest the proper method for restoring the supply. The next year an additional feature was ingrafted, namely, that of the propagation and multiplication of food fishes. Then the Government committed this matter to an executive official, who was held of equal importance with the Minister of Agriculture. In 1879, Congress authorised the construction of a special steam vessel of 484 tons, to serve as a floating station for the hatching of shad and other food fishes.

This vessel being occupied with fish-hatching purposes, another large steamer of 1,000 tons burthen has since been built and put into commission, and supplied with means for deep-sea exploration, in which she has since been engaged. One of the most important features of the work performed by what may be called the fish department is the preparation of the life histories of the principal fishes, of which in June, 1883, Professor Goode stated: "Biographical monographs had been published on the blue-fish, the scup, the menhaden, the salmon, the white-fish, the shad, the mackerel, the sword-fish; and that others were being printed, while similar monographs upon the lobster, oyster, and other invertebrates were ready."

The following is a comparatively late list of the principal species artificially hatched in the United States. The classification followed is that of Dr. Günther:—

1	Brook-trout ..	.. *Salmo fontinalis.*
2	White-fish ..	.. *Coregonus albus.*
3	Lake-trout ..	.. *Salmo namaycush.*
4	Pike-perch ..	.. *Lucioperca americanum.*
5	Atlantic salmon	.. *Salmo salar.*
6	Shad ..	.. *Clupea sapidissima.*
7	California salmon	.. *Salmo quinnat.*
8	Striped-bass ..	.. *Labrax lineatus.*
9	Land-locked salmon	.. *Salmo salar, var. sebago.*
10	Oquassa-trout	.. *Salmo oquassi.*
11	Sea-bass ..	.. *Centropristis atrarius.*
12	Grayling ..	.. *Thymallus tricolor.*
13	Sturgeon ..	.. *Acipenser sturio.*
14	Smelt ..	.. *Osmerus mordax.*
15	Herring ..	.. *Clupea harengus.*
16	Alewife ..	.. *Clupea vernalis.*
17	Oyster ..	.. *Ostrea virginiana.*
18	Cod	.. *Gadus morrhua.*
19	Haddock ..	.. *Gadus æglefinus.*
20	Carp ..	.. *Cyprinus carpio.*
21	Spanish mackerel	.. *Scomber colias.*
22	Cero ..	.. *Cybium regale.*
23	Moon-fish ..	.. *Chætodipterus faber.*
24	Silver-gar ..	.. *Belone longirostris.*
25	Gold-fish ..	.. *Carassius auratus.*
26	Tench ..	.. *Tinca vulgaris.*
27	Soft-shell clam	.. *Mya arenaria.*

In 1883, the Commission had thirteen hatching stations in operation. Mr. Goode writes: "It has been demonstrated beyond possibility of challenge that our great river-fisheries, producing in 1880 48,000,000lb. of alewives, 18,000,000lb. of

shad, 52,000,000lb. of salmon, besides bass, smelt, and sturgeon, and worth at 'first hands' between 4,000,000 and 6,000,000 dollars, are entirely under the control of the fish culturist, to sustain or destroy, and capable of immense extension."

The work done at two hatcheries out of the thirteen must suffice for extract: "The hatchery at Northville, Michigan, under the direction of Mr. Frank N. Clark, passed into the hands of the United States Fish Commission in 1880, and is now one of the most important stations for *salmonidæ* in the world. It is provided with natural and artificial ponds, in which brook-trout, rainbow-trout, land-locked salmon, and lake-trout are kept for breeding purposes. In addition to the eggs obtained from these ponds, many millions of eggs of the white-fish, lake-trout, and wall-eyed pike were obtained in the waters of Lake Erie, and forwarded to Northville, to be hatched and distributed. During the season of 1882-3, 70,950,000 eggs of the *salmonidæ* were hatched and distributed in different waters." During the next season it was expected that fully 500,000,000 eggs of the white-fish alone would be hatched."

Canada has been very energetic in preserving and increasing her fish supply. Government hatcheries are being constantly erected. The authorities there are satisfied that by artificial propagation, and some protective measures, not only can natural salmon rivers be kept thoroughly stocked, but that rivers which have been, like the Thames, in England, depleted, brought back to their former excellence.

In the discussion which followed the delivery of Professor Huxley's paper on "Fish Diseases," at the Fisheries Exhibition, Professor Goode (U.S.) gave a few figures illustrating what fish culture could do. He said: "The Sacramento River, California, was, owing to the large number of canneries there, to a large extent depleted of its salmon; but by the establishment of a hatchery there he had turned out something like 67,000,000 of eggs or young fry of the Californian salmon in the past eight or nine years, one fourth of which were put into the Sacramento River, and it was now much more productive than ever before. On the Clacamass, in Oregon, a similar experiment was tried some years ago, with a like result. These experiments had clearly shown that the salmon industry of the Pacific coast, which was now producing fish to the value of 3,000,000 dollars a year, was thoroughly under the control of fish culture. He might also take the case of the Connecticut in the last century, which was one of the most productive of rivers; but by the construction of a great dam, 60 miles above its mouth, the salmon were cut off from the spawning ground, and for nearly ninety years not a salmon was to be seen. In 1866, or thereabouts, the Commissioners of Connecticut began to plant salmon in this

river, and four years afterwards they began to appear. In the first year 500 fine salmon, of 15lbs. to 20lbs. each, were taken; in the following year an almost equal number. Since the Commissioners have discontinued salmon culture in that river, the supply has again fallen off, and the river may be now considered practically deprived of its salmon again."

A short description condensed from Mr. Day, on the manner of obtaining ova of *salmonidæ*, will make some matters not generally understood clearer. He says: "There are three sources from whence ova can be obtained—from fish living in a wild condition, robbing the redds in the rivers or streams, or else from such as are kept in the breeding ponds. Having captured what appears to be a breeding salmon, in a suitable condition, such may be ascertained by exercising a little pressure along the abdomen, when milt from the male or some ova from the female will be extruded. Occasionally, in the latter sex, a little coaxing is necessary, as she will not always yield it at the first pressure. If the ova are not quite ripe, the abdomen, though distended, will be felt hard and somewhat unyielding; whereas in ripe fish it is soft, and the ova can be felt moving under the pressure of the hand. It may be that ripe females are present, but no males, and consequently it becomes necessary to consider whether females in this condition can be retained so for any length of time. In some localities they may be placed in small contiguous pools, or tubs, or such like conveniences, or even secured by a cord tied around the tail. The same proceedings may be adopted for the male fish, while it is always desirable to retain one or two of the latter sex in reserve; or milt may be kept closely corked in a phial for several days, until required, it having been found to be fertile up to the sixth day. [The milt, or seminal fluid, of the male is of a thick, milky appearance, which, under the microscope, is found to consist of innumerable microscopic organisms, termed spermatozoa, resembling a small head with an elongated tail.] At Howietown, it has been shown that among trout and char the extrusion of milt or ova can be delayed by placing the fish in a smooth box, through which a stream of water flows, and thus apparently demonstrating that external pressure is necessary, and from a rough surface; in short, that mechanical assistance is required for the extrusion of the eggs."

The natural manner of the salmon spawning will make the remark plain about mechanical assistance. The same writer says: "The spot where the salmon redd is to be formed in the river or stream having been selected, the female lies on her side, and, by rapidly working her tail to and fro, fans up the gravel until she sinks gradually into a kind of trough; the male remaining near, and ready to give battle to any intruder. The female deposits her eggs in the trough which she has constructed, which are

fertilized by the male, and covered with gravel. The coarse gravel is frequently employed by the female to aid her, by friction, in the extrusion of her ova."

Returning, however, to the artificial spawning, the apparatus required is not large or costly. "A shallow tin or earthenware pan for receiving the eggs and milt, the latter being furnished with a depressed spout for the purpose of passing them into the tin carrying-pan, this latter having a perforated lid. A jug for clean water is likewise required, and a dry cloth is useful for securely holding the fish. A large salmon is a difficult object to keep steady, often requiring as many as three persons. Some operators prefer to grasp the head of the fish between their knees. The fish is held with its body somewhat sideways, its tail downwards, and its abdomen slightly turned towards the operator; while the pan to receive the eggs is placed as near as possible to the vent. Gentle pressure is exercised on the fish, commencing from the ventral fins and passing downwards towards the vent. Should the eggs not appear, it does not always follow that the fish is not ripe, and operations on it should be suspended for a few minutes, when it will sometimes prove more accommodating. If, however, it is not quite ripe, it may be kept a day or two, or even more, in a suitable place, in order to allow the eggs to mature; but force is never to be employed, for if by such means immature eggs are extruded, the produce will be valueless, and the old fish perhaps mortally injured. Having obtained ova, or milt, the fish should be gently retransferred to the water, and no deleterious consequences follow the operation. If the eggs do not come out quite easily, give the tail a gentle shake to loosen the eggs that remain in the abdomen; but recollect if you use force you will spoil the experiment. The eggs must run out quite freely."

Crossing the globe, by the aid of a fresh paragraph, Mr. Arthur tells us, in his pleasant manner, how the fish are caught for stripping in the Water of Leith, near Dunedin. "A mild night, without moon, but not too dark, and the water clear, are the most favourable conditions under which the fish may be taken. Provided with a lantern throwing a good strong light, attached to a waist-belt or carried in the left hand, a large scoop-net in the right hand, and his legs enveloped in gum-boots, or waders, the manager quietly enters the bottom of a pool. His attendant carrying a large metal bath or tub, for transport of the fish, moves along the banks of the Leith, and keeps near him. On approach, a fish, which can be readily seen by an experienced person, moves up stream, slowly, however, as compared with what its movements in daylight would be. By quickness the net can generally be passed under the fish ere it can get away, and should the fish be near spawning, or milting, it is at once transferred to the tub with a sufficient supply of water. Thus confined

the trout shows considerable restlessness at first, but soon gets reconciled, seemingly, to its novel habitation, as it becomes more quiescent. But should the fish when taken not be near maturity, or ready to propagate, it is returned to the river. Working thus up stream, pool by pool and stream by stream, so much only of the river is gone over as gives a number of fish sufficient to transport in the tub. When this is obtained, Mr. Deans and his man carry the tub and its contents carefully to an enclosed stream, or small pond, within the gardens. This is called the 'hospital' or the 'lying-in pond,' and there the milters and spawners are kept till ripe or ready for stripping. More than a score of trout, some 10lb. to 12lb. weight, have thus been taken on a good night, but some nights scarcely a fish can be seen." The process of stripping has been already described. It is worthy of note that, as in the other hemisphere, Mr. Arthur says that the proportion of males compared with the female fish captured are few.

There are two processes for the treatment of ova—the wet and the dry. In the first-mentioned, some water is placed in the pan which receives the eggs when taken from the fish, with which the milt is mixed. The dry plan dispenses with water altogether, the eggs being pressed into a dry pan, the milt of the male being distributed over them, when the ova and the milt are gently shaken to insure their mixing and fertilization. Unless the mixing is well done, the ova remains infertile. After the mixing is complete, a little water is poured into the pan and stirred with the hand gently, and allowed to remain, for some thirty to forty minutes, until the ova hardens, and becomes hard, round bodies. The eggs when extruded, it must be remembered, are soft, and prone to adhere to what they come in contact with; hence the process of hardening in the manner described. As soon as the hardening is complete, more clean water is poured over the ova until it ceases to be discoloured, when the eggs will be cleansed from useless milt and are ready to be transferred to their destination. The dry process of treatment is said to be the most successful.

"The egg, or ova," Mr. Day says, "has on its surface a microscopic orifice, termed the micropyle, which is usually considered to be for the purpose of allowing the entrance of the spermatozoa, without which it would be barren and unfertilized." The ova, when first extruded, will absorb water as well as the milt of the male, and if eggs are mixed with water it is evident that unless fertilization rapidly takes place the spermatozoa will have perished. The eggs of the salmon and trout, when kept in water some 44°, at Howietown, take between seventy and eighty days to hatch; but, if the temperature is increased, the period of hatching is lessened; if decreased, the time is lengthened;

hence the use of ice in the transport of ova from one hemisphere to another. Of trout in New Zealand, Mr. Arthur writes: "The period of incubation, if I may use the expression, is found at the Opoho ponds to average seventy-eight to eighty-eight days, under ordinary conditions of weather; and the time from impregnation till the eyes of the fish appear, forty-five to fifty days. A difference in the temperature of the water of 1½° is found to make a difference of ten days' time in hatching. The average temperature ranges from 42° to 52°, but the strongest and healthiest trout hatch out in water at 48°. The period of hatching is from eight to fourteen days; that is, between the first and the last trout breaking out of the egg. The umbilical bag in the young trout hatched in September and October, 1880, took from fifty to sixty days before it was entirely absorbed."

The impregnated ova will be placed into the breeding boxes, or packed, say, for exportation. The two processes are thus described by the Rev. Mr. Tenison-Woods, whose description is chosen for its brevity. He says: "The manner of packing is this. The boxes are about 6in. in height and width, and 2ft. long. On the bottom is a layer of damp moss, mixed with ice if the temperature of the season or the country require it. On this is spread a damp linen cloth, over it a thin layer of ova is laid, another wet linen cloth, and more moss completes the packing, which has to be rather tightly packed to prevent shaking and friction. In many places in Europe, no roe is packed until two black spots appear in the ova (the eyes), because the fish bear transport better in that state. If a long transit be anticipated, the ice arrangements must be different, because melted ice-water injures the roe."

The simplest hatching apparatus consists of a series of shallow boxes half-filled with sand, and placed in a gradually descending plane from first to last. A very small flow of water from a tap into the uppermost box, and from that to the others, will keep the water oxidised and prevent the development of septic germs. It is found, however, that this arrangement has many disadvantages, and leads to a great waste of roe. The uppermost boxes consume the oxygen from the water, which by degrees loses the necessary vitality which is required for hatching the roe in the lower boxes.

The method adopted in Dr. Klenertz's fish-hatching apparatus is this: Each box is supplied with its own stream of water, which is as much mixed with air as possible. The water is brought to a large stone trough, in which the fish (trout) are kept during the summer, until the roe and milt are ready in the autumn. The water runs from this stone trough through numerous separate pipes to two other large troughs—one of stone and the other of

wood,—the sides and bottoms of which are covered with cement; each of these troughs is about 12ft. long, 2ft. broad, and 2ft. deep. Small gratings in the sides serve as rests for the hatching-boxes. These are made of sheet-iron, well painted in oil-colours to prevent rust. They are 1ft. square on the bottom, and 5in. high. They are pierced with two rows of fine holes, and on the top there is a groove, which is likewise furnished with fine holes. After, the box is filled with clean gravel to the height of 3in., and on this the roe is thinly spread. The water which supplies these boxes is conveyed through small perpendicular tubes, each furnished at the end with a rose, so as to separate the falling water and bring it as much into contact with the air as possible. This water falls over the hatching-boxes, and is still further ærated by the fine holes in the tops. The exclusion of much light is essential to the success of the experiment, especially of the hatching. The gravel is boiled for some time before using, to free it from the spores of fungi, which are most destructive to the roe.

There are so many things to say about fish culture that the difficulty is to know what to select for publication. The monks, in the Middle Ages, probably knew more about the matter than our best experts of the present day, as the pisiculture of the religious houses in England remains a mystery yet unsolved. Mr. Day tells us that when the eggs are about to hatch they require considerable attention, for in some the process of emerging from the shell is more easily gone through than it is in others. Generally, if the eggs are small, it has been observed that the young emerge tail first, while in the larger ova they split down the line of the back and the fish may frequently be seen with its head covered by a portion of the shell, which occasionally causes suffocation. Sometimes assistance is necessary in order to assist the embryo from its shell. When the embryo has freed itself from its shell, it has attached to it a conical bag (umbilical sac), suspended under the belly, containing the red yolk of the egg and oil globules, which afford it nourishment during the first five or six weeks. The mouth is at first imperfectly developed, as are the fins, and the whole body has a shape very different from what it is soon to assume, and is very delicate, and almost transparent. The slightest injury is fatal.

After the umbilical sac has been absorbed is a dangerous period for the young fish, for up to that date they have subsisted on its contents. Now they require to be fed; and the Chinese maintain that a large number of young fish die of starvation. Livingstone Stone (if artificial food is employed) advises liver, and curd made from sour milk, mixed in equal proportions; or, still better, two parts liver and one part curds should be used. The curd should be made as fine-grained and moist as possible, while the liver should be reduced to the smallest possible particles. He

recommends grating the liver on a tin lemon or cheese-grater which has small holes not above one-tenth of an inch in diameter. "The fry will divide into two sets, the larger taking the best locality, and driving off the weaker ones, which will herd by themselves. . . . Should they commence dying, due to putrescence of the water, consequent on the subsidence of unconsumed food to the bottom, the best remedy is common earth. A natural river temperature of 50° will, as a rule, produce ample food for the young fry; and prior to the absorption of the umbilical sac they should be placed in ponds of muddy water. They will not bear much handling, but bear carrying very well: a 40-gallon tank being sufficient for the conveyance of about fifteen thousand which have been feeding for more than a month, except for very long journeys, when a supplementary small tank requires to be added, which saves the necessity of handling the fry." Many substances are recommended as food for the young trout. The heart, liver, and lungs of animals killed for the market; English dog-biscuits, ground liver, brains, horse-flesh, worms, maggots, etc.; boiled meat, three or four parts fish meat, one part common flour, the latter stirred in; while "diseased meat" is as poison.

Mr. Day says: "In the trout-ponds of Mayence, Würzburgh, Heidelberg, and elsewhere, the quantity of water which supplies the feeding ponds is comparatively small. They are, however, kept clean, and especial care is taken that saturated leaves do not accumulate at the bottom. In the large establishment of Klein Brothers, Alsace, irrespective of the natural food supplied by the Ill to the fish, horseflesh was exclusively used to supplement it. The horses, before being slaughtered, were carefully examined by veterinary surgeons, and the fish were fed in accordance with their size, the larger ones having the flesh chopped up into small pieces, while it was ground fine for the younger ones. In using this description of meat, very great care has to be taken, or it may, if unwholesome, produce a widespread and fatal epidemic among the fish. In this way Herr Haack lost all his salmonids, large and small, in one day."

From time immemorial there have been fish-ponds, and it would appear from a scriptural writer (Isaiah) that the Egyptians constructed them for economic reasons. As may be expected, all other civilized people followed their example, and the fish-pond only in modern times has fallen into disrepute. This has happened from several causes—from lack of care, from being choked by mud, from being rendered foul from accumulated decaying vegetable matter, from rank vegetation along the banks, and from their not being run dry for many years. The consequence is that the fish of the pond, as a rule, have a muddy or earthy flavour, and have lost that esteem which their fore-

fathers inherited. Mr. Day tells us that fish-ponds must not be left unattended to; they may stand full two or three years, but not longer, unless the proprietor delights in the contemplation of starved fish. The oftener they are dried the better the feed for the fish will be.

The best comparatively modern authority we have on fish-ponds, according to the late Mr. Frank Buckland, is Bishop Dubravius, of Olmütz, in Moravia, who lived in the sixteenth century; and as, with a small outlay, good profit can be assured from fish-culture by this means, some attention can be paid to its conduct. The subject was discussed at some length in the *Saturday Review*, Nos. 1581-1583. Fish-ponds offer a mode of earning money to country settlers now completely neglected, offering at the one time a lucrative and an absorbing occupation. Those who are familiar with this Colony will see with a moment's thought how wonderfully adapted New Zealand is for what may be called *individual* fish culture.

The *Saturday Review* says: "Into the subject of fish-ponds the Bishop goes with great detail, and his advice is as useful in the present nineteenth century as it was in the sixteenth. The chief thing laid stress upon is that, as he says, 'a crop of fish should alternate with a crop of vegetables,' or, in other words, that every pond in turn should be run dry and planted with a crop of some kind of grain before it is again filled and restocked. From this point of view of the merits of 'alternate crops of fish and vegetables,' he also recommends the 'three-pond system,' and says: 'Suppose three ponds to be in existence—A, B, and C. Let the water be run off from pond A completely, and as it empties catch the fish and place them in pond B. Having let it run completely dry, plant the mud with oats, barley, cabbages, or rye-grass. The crops having been in due time reaped, refill it in the winter and stock it with fry; then dry and plant B. At the same time dispose of all the larger marketable fish, and put the half and three-parts grown fish into pond C, which now for the first time is taken into the regular round of cultivation. Thus, with three ponds worked upon this system, the proprietor will always have a crop of vegetables growing in one pond, yearling fry in another pond, and breeders with the fish fattening for market in the third.' No system that has ever been invented is better than this. By following this advice one of the greatest difficulties, as well as the heaviest expenses—*i.e.*, the clearing out, or, as it is technically called, 'mudding' of ponds—is entirely avoided, and the necessary turning up of the mud-soil by the plough ensures the fattening of the fish when they are placed in it the following year. By the simple device of planting, not only is the waste ground of the pond utilised, but the crops grown therein are found to be unusually heavy, especially when oats are sown, which

flourish in the mud soil. Barley also grows well in the mud, and is particularly good for the fish that come after it when the pond is refilled. Another excellent reason for drying, ploughing, and planting ponds from time to time is that it is one of the new, efficacious ways of getting rid of that aquatic plague, the American weed, which is one of the greatest nuisances of the fish-ponds in this country, as well as of the rivers. As a rule, the process of drying and ploughing will be found a sufficiently drastic remedy for this pest; but, if it is in any very great quantity, it is well to make assurance doubly sure by trying a dose of common salt also."

The late Mr. Frank Buckland recommended, as regards the feeding of the fish: "A dead cat or rabbit, unskinned, should be hung up in a tree over the pond. The gentles resulting from the blowflies will fall into the pond, and afford excellent food for the fish. Care should also be taken to collect, after a shower at night, by the aid of a lantern, the large lobworms that are then plentiful." One very curious fact about fish-ponds, recorded by Mr Buckland, is that the presence of ducks on a pond is an immense advantage to the fish, which he explains by the fact that the habit which ducks have of "rooting" with their bills in the mud enables the fish to get at a quantity of minute insects, while the loosening of the mud gives facilities for the water creatures to breed. So distinct is the improvement of the fish under these circumstances that Mr. Port, who had charge of the experimental ponds at Reculver, told Mr. Buckland that when handling eels, even in the dark, he could tell from their size whether they came from a stream of which ducks and geese had the run. Of course, both ducks and geese must be kept away from ponds when the fish are spawning, as they will, if allowed, devour immense quantities of the fish eggs. In a book published in 1713, called *A Discourse of Fish and Fish-ponds*, by the Honorable Roger North, it is advised that cattle should be allowed to come and drink and stand in fish-ponds, as it conduces much to the thrift of the cattle, as well as to the feed of the fish. The disturbance of the mud, and the consequent increase of fish food, being evidently the object in view. The time of draining is another question much discussed. In the Limousin, where carp-breeding in ponds is largely carried on, the ponds are drained in turn every three years, in the month of October. In Germany, also, ponds are drained every third year. In some parts of Austria the fish-ponds are drained every two years. Mr. North says: "You may let your ponds stand full two or three years, not longer, unless you delight to see starved, lean fish."

One of the greatest difficulties with the young of pond-fish is feeding them. Mr. Marston writes: "The umbilical sac, on the contents of which the trout alevin exists for six weeks, lasts the

alevin of the coarse fish but a day or two, and unless the young fish are fed they will die; hence the difficulty of rearing them in confinement. Dr. Kelson made the valuable discovery that the animalculæ bred in water containing vegetable matter are eagerly devoured by the young fry." Acting on this knowledge, Herr Fruwirth, the Austrian pisciculturist, has adopted a most ingenious plan for the production of food for his fish-ponds. He has a number of small ponds or ditches containing stagnant water and aquatic plants, which are used as nurseries to propagate the larvæ of insects, small crustaceans, and other low forms of animal life, on which fish naturally feed. From time to time some of the water swarming with these creatures is admitted to adjoining ponds of water, in which the fish live.

Captain Pierce says that nursery ponds, if in proper condition and containing a good growth of aquatic plants, will support 1,000 to 1,500 carp yearly per acre of water. Stock-ponds, in like condition, will support 500 two-year-old carp per acre. Over-stocking carp ponds would produce the same result as over-stocking pastures with cattle.

Besides fresh-water, salt-water ponds can also be constructed. They must, of course, be in places where sea-water can enter at half-tide. The sea-water is to be introduced by means of a sluice at this depth, with a proper grating. By this means a regulated amount of water can be maintained at low tide, and 8ft. or 10ft. at flood, and the water will be always changing. A great many of these ponds have been constructed in Europe. The fish kept in them are those of the neighbouring seas—such as turbot, sole, brill, plaice, flounder, rays, skate, herring, salmon, salmon-trout. The depth is usually not much over 12ft., or less than 3ft. at low water. Various other fishes have been tried, but the above enumerated have succeeded the best. Turtles have been kept in such ponds. They are now to be seen in the tanks provided for them at the Indian and Colonial Exhibition. The food generally consists of butchers' offal, mingled with blood, besides periwinkles, shrimps, and prawns.

Columella gives us directions as to where and how to construct proper marine fish-ponds. He particularly recommends them in insular situations, where the soil is poor and the returns small or none. In such situations they may be turned to excellent account. Mere sterility, however, ought not to be the only consideration in determining the site of a sea-pond; several other things, as we shall presently see, should also enter into the account; but, when these are present, the best place to commence operations is so near the sea that its waters may easily wash through, and never stagnate, thus imitating the great main whence they are derived, which, never being of the same temperature, is in perpetual

motion, and renewed every hour. They may be made of tiles, *opus signinum*, or be excavated in the solid rock. In either case, in all such ponds as are not perpetually motionless and asleep, that extremity which lies farthest from the sea, and is deeper and cooler than the other, should conduct by straight or tortuous channels into a grotto, where the scaly troop may retire from the heat of the day, like cattle, for refreshment and cover. The watery alleys leading to these places of repose should not be too broad for *murænæ*, which prefer a narrow, nestling trough. Some, however, object altogether to mixing *murænæ* with other stock, as they are liable *to go mad, like dogs*, and in that case will bite, run down, and destroy every other species shut up in the same reservoir, till they have entirely consumed them. In feeding these reservoirs the supplies of water should be let in from one side, and the issue, if possible, be made to take place at the one opposite. This will secure a perpetual renewal of the water, which is a matter of prime importance here. A convenient coolness being also of equal consequence for the salubrity of the fish, the deeper the source whence the sea-water is procured the better; and, whenever it is practicable, the pond should fill itself from below. When the vivarium to be formed is scarcely above the level of the sea, its basin should be dug out about 9ft., and the conduit pipes placed about 2ft. from the top. They should be as capacious as possible, to admit sudden flushes of water, which will help the issue of the stagnant mass lying below the sea level. . . . In providing for the issue of the water from the pond, the exundation is best effected by means of a brass grating, with apertures of a size sufficiently great to let it run freely out, but too small to allow the escape of the young fish. If the dimensions of the pond permit, it is no bad practice to remove fragments of rock, covered with seaweed, from the neighbouring shore, and to scatter them here and there in these little enclosures, in imitation of the open sea. As the *gîtes* of the fish are very various—some lying on a bed of sand, some ambushed in mud, others feeding among the rocks—your pond should be constructed according to the character of the sea in the neighbourhood; and, finally, when the work is completed, a series of stakes should be planted in a semicircular form round that part of it which lets in the water. These must be placed above the level of the waves, so closely as to break the force of the infringing waters, and to keep out the wrack and weeds which would soon else fill the piscina. Having thus constructed and secured the pond against casualties, the next point should be to stock it wisely; for, as on land, all fields will not bear the same crops. Just so is it in the vast acreage of waters. We must not think, for instance, because we find inexhaustible supplies and multiplication of mullet (red mullet) at large in the open sea, that we shall therefore succeed with them in a pond. On making the experiment we shall have the

mortification to learn that rarely one or two out of many thousands of these delicate fish will bear a pond life. So, too, there is little use in imprisoning fine exotic fish, whose requirements are not well understood. Such stock may live indeed, but they will not multiply, and so are without profit. "In regard to poor fish, we make," says Columella, "no mention of them, since they are neither worth the capture nor rearing; but, as all good fish do not thrive on the same bottom, study that which is prevalent along your own shore, and according as it is stony, sandy, or muddy, do you imitate the same peculiarities in your stew. An oozy bottom does best for flat-fish—as soles, turbot, and plaice. Such a pond, too, is the best nidus for all kinds of coquillages — oysters, scallops, etc. A sandy bottom, though not absolutely bad for flat-fish, suits the open sea fish best, while it is less congenial to the growth of shell-fish." Columella tells us that it was customary to bring fish from the sea and turn them into lakes; and he mentions the names of several persons who had succeeded in their experiments.

The ancients were much more advanced in fish culture than ourselves. Artificial pieces of water for fish-ponds are of great antiquity. From the Egyptian paintings we see that those people used them, and they were in common use amongst the Greeks and Romans, coming down even to medieval times in connection with monastic institutions. The most extraordinary announcement in Columella is that the Romans turned lakes and rivers into natural vivaria. They placed fish and fish-spawn in them, even the ova of marine fishes, which were known to ascend fresh-water streams. Thus they stocked, with perfect success, several large rivers, which he names.

An interesting paper upon pond cultivation in Prussia was published in the *Deutsche Fischerei Zeitung*, of February 7th, 1882. Herr Eben Bandilten had a meadow, 10 acres in extent, in a very favourable and sheltered position, which was alternately employed as a pond for rearing fish and for agricultural purposes. In August, 1881, when the second crop of grass was just ready for cutting, a flood covered it to the depth of 5ft. In previous years he had employed it as a spawning-pond; now he decided to use it for raising and fattening carp. Knowing the quantity of food it contained, he stocked it in the spring with about 500 carp, weighing on an average 1lb. to 1½lb. each; 400 ides (*Cyprinus orfus*) of different sizes; a few eels, and ducks in the proportion of one to each carp. He succeeded very well; 300 ducks, 100 geese, and 2 swans making this pond their summer residence. He expected, and his expectations fully realised, that these aquatic birds would furnish a good deal of other food for the carp. Frogs at first abounded, but the ducks cleared them off. About the beginning of October, 1881, he had about 50,000 very fine young

carp, 100 of them weighing about 2½lb.; of ides he had only about 100. The old carp had increased in size from 100 to 150 per cent.; the ides not quite so much.

With the consideration of fish-ponds, the mode of hatching coarse fish, such as perch, pike, roach, bream, and other varieties, naturally arises, although public attention seems to be almost entirely directed to the culture of *salmonidæ*. Some 120 years since, Mr. Lund, a Swedish pisciculturist, moved in coarse fish culture—such is the common phrase,—and invented a hatching-box, which bears his name and is described below, and under the heading "perch," in this section of the handbook. Coarse fish cannot be cultivated in the same way the *salmonidæ* are. Mr. Marston tells us that it is not only difficult to manipulate the eggs in troughs and trays, but the difficulty of rearing the young fry is much greater. They are hatched out as perfect fish, at once requiring extraneous food, and they are so extremely small that all attempts to feed them artificially have failed. They appear to require that as soon as they leave the eggs they should be able to seek their own sustenance on the almost invisible animalculæ present in their native waters. But to cultivate these fish artificially is not only difficult, but unnecessary. All that is necessary is to aid nature to a certain extent by placing parent fish in suitable places for spawning, and then protecting the eggs until the fry hatch out.

A still more simple contrivance is what may be called the breeding hurdle, which consists of an ordinary hurdle on which branches have been intertwined. It is sunk in a pond, lake, or stream, in any shallow, undisturbed spot, and the fish find it a convenient place on which to cast their spawn, which can then be taken out and transferred to other waters, or left to hatch out. This mode of collecting ova is largely used in France and Sweden.

"The spawning of coarse fish," Mr. Chambers writes, "varies from the *salmonidæ* in this respect: that whereas the latter shed their ova in the winter, free, or non-adhesive, on gravelly bottoms of streams, the others yield their ova in the spring or summer months, and select stones, trunks of trees, weeds, rushes, etc., upon which to attach the eggs, which are adhesive in character."

Mr. Day gives a list of fishes which he considers best suited for river and pond cultivation, excluding the *salmonidæ* and andromous fish. They are as follow:—The perch (*Perca fluviatilis*); burbot, or eel-pout (*Lota vulgaris*); pike, or jack (*Esox lucius*); carp (*Cyprinus carpio*); gudgeon (*Gobio fluviatilis*); roach (*Leuciscus rutilus*); chub (*Leuciscus cephalus*); dace (*Leuciscus vulgaris*); rudd (*Leuciscus erythrophthalmus*); tench (*Tinca vulgaris*); bream (*Abramis brama* and *A. blicca*); and the loach (*Nemacheilus barbatula*).

Mr Chambers, in his paper on the "Introduction and Acclimatization of Foreign Fish," in the *Fisheries Literature*, recommends the introduction of the Rhine, Californian, and land-locked salmon (*Salmo levenensis*); and the lake-trout of Switzerland (*Salmo ferox*), the American brook-trout, the mirror-carp from Westphalia, the black-bass of Canada, and the golden-tench (*Tinca vulgaris*).

Among the fish that would appear desirable to introduce into New Zealand, is the black-bass of America *(Micropterus pallidus)*, although the cultivators of salmon give it an evil reputation, Professor Goode going as far as to say that with fish with which public fish-culturists should deal, the black-bass had no claims whatever, unless he were put into the same stream with the pike, and let them fight it out together. But at the same conference the Chairman (the Marquis of Exeter) put in the plea that the black-bass would, in certain waters, be a useful addition; he would rise to a fly; he would take any kind of bait; he would live with the pike; and he was exceedingly good eating. He thought the flesh was decidedly more like fresh whiting than any other fish.

A writer in the *Fisheries Literature* says: "The black-bass is a fish esteemed by North American anglers—even above the trout. It is a fish of prey, like the perch, and should, of course, not be placed in trout or grayling streams; indeed, it thrives best in ponds and lakes. In sport and food qualities it is undoubtedly superior to any English coarse fish. The successful importations of it made by the Marquis of Exeter, and some other gentlemen, prove conclusively that it will do well in this country (*i.e.*, England); indeed, it is doubtful if there exists a more hardy fish, or one which can be more easily cultivated. This will be made evident by a short description of the wonderful manner in which the black-bass provides for the safety of its young—in striking contrast to the habits of nearly all other fish. The black-bass spawns in May or June, according as the season is early or late. The parent fish go in pairs, and select some place where the bed of the water they inhabit rises nearly to the surface, where the sun's warmth may reach the eggs. If they can find no convenient shallow, they will heap up stones on the bottom and make one. Before the eggs are deposited, the parent fish most carefully clean the space they have selected by brushing it with their fins, and by carrying away from it with their mouths all *debris*, such as twigs, stones, etc. These cleaned spaces are readily distinguished by their contrast to the dark weed-covered ground around them; and many of them may be seen in the lake (White Water) in Burleigh Park, in which the Marquis of Exeter placed some hundreds of black-bass a few years ago."

American observers of the black-bass have placed things on these cleaned spaces, and have seen them carried away and deposited outside by the black-bass. The nest prepared, the female deposits her eggs in it, and the male impregnates them. Then both fish keep jealous guard over them for some ten days, when the young hatch out. Every intruder is fiercely driven away. Nor does their care cease here; for, keeping their young together, as a hen does her chickens, they convey them to some shallow place amongst reeds and weeds, where they will be safest from the attacks of other fish. This care is continued for some days, until the fry are strong enough to scatter and look after themselves. A few parent fish will stock a water without aid of any kind. To place a very limited number of fish in a large sheet of water might result in their becoming too much scattered to get together again in the breeding season; therefore it is advisable to place them in very small ponds, or else enclose with wire-netting a portion of a large sheet of water, and keep them there until they have spawned.

Of the black-bass, in an economic aspect, a gentleman, writing to the Philadelphia Board, says: "An approximate estimate of the number of these fish that are annually taken will show their value to the State. It is given on reliable authority that each boat in the Susquehanna will make a daily average catch of 10lb.; and from close observation it has been ascertained that there are not less than ten boats to the mile engaged in fishing. This, for a stretch of 20 miles, would make the daily catch in that distance 2,000lb., which, at 10 cents a lb., would amount to 200 dollars. This is a very low estimate, and taking in all the water of this river — from the mouth to Wilkes-Barre on the North Branch, and the West Branch—there is no doubt that the average catch of these fish will not be less than from 5,000lb. to 10,000lb.; and of money value to the amount of nearly 100,000 dollars annually. Frequently, from ten to twenty boats can be seen in water that will not cover a space of 10 acres. In its native waters it attains to a weight of 6lb. or 8lb., and is much esteemed for the table."

On the artificial hatching of marine fishes, Mr. Day says: "The principle acted upon in some fresh-water fisheries, of supplying undue depletion by artificial hatching of fish, has likewise been attempted in the United States with respect to sea fisheries. It is carried out there by Government Commissioners. . . . The first species which the United States Fish Commission attempted to propagate on a large scale was an andromous shad (*Clupea sapidissima*). . . . In many localities where this artificial shad propagation has been carried on, the success has been very great. In 1867, 2,000,000, and in 1869 4,000,000, were hatched in the Connecticut river; and in 1872

the largest catches were made that have occurred since 1811. In short, in many localities where artificial propagation has been in vogue, the increase of fish has been most remarkable, while new colonies of them have been established."

The propagation of marine fishes has been carried on until lately in floating boxes connected by cords, the foremost box being held in its place by an anchor. According to Mr. Day, it was found that during strong currents there was sufficient movement for the eggs; but when the tide was slack they rested in masses at the bottom of the boxes, and in consequence suffered greatly, being very liable to fungus, especially when the temperature was high, unless shaken up by the hand, while, during storms or floods, they were not unfrequently upset or carried away.

In 1877, a Mr. Fergusson invented a plunging bucket, which apparatus had a great superiority over floating boxes, especially in hatching eggs in waters where all currents were absent; also because a cooler stratum of water could be readily reached when the surface was too hot for the proper development of the eggs, a condition always present when the temperature rose above 80°. By covering the tops of the buckets with caps of wire gauze they might be sunk to the required depth where a cool stratum existed, and that without any escape of the ova. The apparatus is thus described: It was placed on a large scow 50ft. long and 19ft. wide, and consists of a shafting along the centre of the scow, upon which at intervals are placed irregularly-formed cans, which have a long and a short side. This is accomplished by making the outline of the cans two intersective cycloid curves, which produces upon the lever following its circumference a quick fall and slow rise at the extreme end. A steam engine is the motive power revolving the shafting and cans. To the ends of the levers are suspended cylinders of sheet-iron from 1½ft. to 2ft. in diameter, having a wire-cloth bottom, and within these the eggs are placed. The rise and fall in the water does not exceed 5in. A slow revolution of the shafting produces all the agitation in the water essential to the welfare of the eggs, a more rapid motion having a tendency to draw the eggs hard against the wire cloth. The slow rise and quick fall of the cylinders also saves the eggs from this injury, as the effect is to throw the eggs high up as the bucket goes down, while, as it rises slowly up, they fall gently to the wire-cloth at the bottom. Each bucket will hold 20,000 shad eggs.

But there is a far simpler plan in what is called "Wright's Submerged Wave-action Hatching Box," which is thus written of:—A cubical box, with a hinge cover of wire-cloth, the sides being of galvanised iron; the bottom, which is of the same material, being provided with circular openings an inch in diameter, each covered with valves opening upward, to admit

water from beneath. In the interior of the box, an inch above [illegible] the valves, is a wire tray, upon which the eggs are allowed [illegible] to rest, and through which the water can readily pass. The sides [illegible] of the box are prolonged downwards to form an expanding rim, [illegible] which serves to deflect the current upward through the eggs. The [illegible] whole is suspended from a float, and held in position by means of [illegible] a small weight fastened to the bottom. Length, 10in.; width, [illegible] 10in.; depth, 12in. This box, invented for shad hatching, is [illegible] claimed to be suitable for open streams when the current is [illegible] slight.

The ova of the cod has been artificially propagated, as it [illegible] was considered possible not merely to increase the supply where it [illegible] already existed but also to establish new fisheries in places where [illegible] the young should be turned out. The best results are said to have [illegible] been obtained at Gloucester, Mass., where those released were [illegible] known to live, as many young fry were observed playing round the wharves where young cod had never been previously seen. The eggs having been taken in a pan, having a little water at the bottom, the milt was at once added; after which water was slowly mixed until the pan was full. But for successful hatching it appears necessary to give a certain change to the water, and partially keep sediment from the eggs. Various appliances have been invented to aid the hatching of ova, when it was found that spawning fish could be collected off the American coast with little difficulty, and brought to the harbour alive in a common, welled-smack, and then transferred to the hatchery—where, if necessary, they can remain to ripen—and thus hundreds of millions of eggs can be secured in a single season. The young hatch well, and appear hardy; and, as observed from the ovaries of twenty-five good-sized cod-fishes, if all the eggs were hatched, would furnish more fish in number than are captured in one year by the combined fleets of cod fishermen from all the different fishing ports of the United States during the most prosperous season.

As several of the edible fish of the New Zealand waters belong to the same family as the cod—*i.e.*, the *Gadidæ*—an interest may be taken in the manner in which the cod spawns from the [illegible] that the habits of the family may be similar, if not [illegible] in the propagation of their kind. In the [illegible] annual report of the Fishery Board for Scotland [illegible] paper entitled "Observations on the [illegible] Ewart and Mr. George [illegible] who have such fish [illegible] The condensation [illegible] 1885. Th[illegible] years since G. C[illegible] believe, th[illegible]

the eggs of the cod float on the surface of the sea, and only sink when dead. Sars's after investigations showed that the eggs and the milt are of less specific gravity than the sea-water, and consequently float, and that the micropyle lies near the lower portion of the egg. Experiments were carried on in the Rothsea Aquarium on fish which had been in the tanks for four years. In February several cod appeared to reach maturity; early in March the fish refused food, and a few days afterwards eggs in an early stage of development were floating on the surface of the water so abundantly that hundreds were collected in a few minutes by means of a piece of muslin placed over the overflow of the tanks. The temperature of the water was 43° Fahr., and the specific gravity a little over 1·24. The eggs were usually found during the first few days in from the 2 to 8-cell stage at 8 a.m., so that they were probably shed about daybreak. Later batches, shed between 6 and 7.30 p.m., were found at the latter hour with the disc already forming. The great transparency of the living eggs makes it almost impossible to notice them as they rise through the water; while the dead eggs, being slightly opaque, are easily recognised as they are carried to and fro by the currents. For some time before the eggs reach maturity, and during the early part of the spawning period, the fish not only refuse food, but give up their regular movements around the tank, and swim about in small groups, or rest together at the bottom, swimming and resting alternately. Sometimes a single female would swim leisurely about for a few minutes, attended by a single male, and often would settle down in a corner of the tank and rest till disturbed by her attendant. The activity of the males was specially evident at dusk and in the early morning, *and it was apparently during these periods of activity that the eggs were shed and fertilized.* One day, for example, there were no eggs visible on the surface of the water at 6 p.m., while a considerable number were obtained at 7.30 p.m., which, as the germinal disc was not completely formed, had in all probability been quite recently shed while the fish had been swimming about in groups. From the observations made, it seems, as suggested by Sars, that *the eggs and milt are shed while the fish are swimming freely about in the water. The males swim indiscriminately among the females—sometimes over, sometimes under them—fertilizing the water through which the shed eggs are slowly rising to the surface.*

"The females, like the *salmonidæ*, are capable of withholding the flow of ripe eggs to a certain extent. A limited number are ripe only at one tim[illegible] if the unripe be forced out they sink to the bottom, and [illegible]le of being fertilized. The ripe unfertilized egg has a r[illegible]ce, and is moreover not so transparent a[illegible]s an egg begins to die or to develo[illegible]s, ar[illegible]

to the bottom. Whether fertilized or not the eggs float immediately after extrusion, but in the latter case they die and sink to the bottom in twelve to fourteen hours."

These deeply interesting details respecting the cod, provoke curiosity as to the floating of the eggs of other marine fishes, and may possibly throw light on the schooling of certain varieties. And here, happily, a lecture delivered by Professor McIntosh, last year, at St. Andrew's University, gives us the very details that are desired. No excuse can be needed for a condensation of its more important portions. The lecturer said, *inter alia*, a feature not sufficiently insisted on is the fact that only a portion of the ovary in most marine fishes becomes "ripe" at a given time. This provision appears to be admirably suited for the increase of the fishes, a constant succession of embryos being thus liberated, and time afforded for those of one stage to disappear before those of the succeeding take their places. The importance of this point in the history of the eggs of fishes will appear in connection with legislation fixing close seasons, as the American cod, for instance, begin to spawn in September, while some continue as late as June. On the other hand, the salmon, trout, and many fresh-water fishes appear to divest themselves of their spawn in a day, or two, or three.

The popular impression is that most fishes deposit their spawn at the bottom of the sea, and many assert that fish migrate shorewards to deposit their ova in shallow water, but the number of marine fishes which are supposed to deposit their eggs on the sea-bed is yearly diminishing, while the ranks of those in which the ripe eggs are found floating correspondingly increases. Thus, the majority of the American flounders, certain kinds of wrasses (*Ctenobabius*), a species of sparling (*Osmerus*), several species of cottus, cod, haddock, gurnard, shad, mackerel, and Spanish mackerel, a kind of dory (*Zeus*) and the frog-fish are among those which have floating eggs. The eggs of the plaice and the lesser weever are equally buoyant.

When placed in a vessel of sea-water, the eggs from these kinds of fishes persistently float on its surface, descending but a very little when the jar is rudely shaken. Even after a protracted journey only the dead eggs roll on the bottom of the vessel. All the floating eggs are living. · · · Sars mentions that if the eggs of the cod are placed in fresh-water they sink and never rise again. They are killed just as a newly-hatched salmon is killed, though somewhat more slowly, by immersion in sea-water. More than once the eggs of the haddock and other fishes have been brought under notice as lying on the bottom of a vessel, and therefore held as proving that the ova did not float. But in every case such eggs were found to be dead, dying, or unripe, or not fertilized.

The eggs of the gurnard float as buoyantly as those of the cod, but they are much larger. The rapidity with which the hatching proceeds is worthy of notice, "for in seven or eight days the young are extruded, whereas in the salmon, for instance, no less than sixty days are required, even in a room with a temperature much higher than that of the open air. If the eggs of the salmon are permitted to hatch in an ordinary river, a period of from 95 to 120 days is usually necessary."

In May, of last year, the eggs of the flounder were found to float. Before the English summer of 1885 it was not known whether the ova of the turbot, sole, and lemon-dab floated or sank; but the ova of each were found to float buoyantly, as that of any other fish, and, the Professor adds, "the notion therefore that such fishes seek the shallow water for the purpose of spawning is visionary, and mainly rests on the preconceived opinion that the eggs are deposited on the bottom."

The result of inquiry, then, appears to be that marine fishes, as far as can be ascertained, save those of the herring family, which are regarded as edible, deposit buoyant eggs in the waters of the sea, which serves as their hatching place. Professor McIntosh adds: "The comparatively small eggs of the chief food fishes rise to the surface, or nearly to the surface, wherever the shoal of adult fishes happen to be feeding, and this occurs not during a brief period but extends over a considerable space of time. The tiny young, in their helpless state, are carried along with multitudes of eggs, by every tide, into sheltered creeks and bays, in the shallow water of which they find both shelter and food. . . . They are carried hither and thither by every surge of the tide, or more steadily borne by the deeper currents to stock anew exhausted waters. The minute and imperfectly-developed embryos, and the delicate young, are conveyed into regions best suited for their growth and well-being. . . . They are placed from the first amidst a rich surface-fauna of minute forms which serve them as food."

Step by step it will be seen by observation that an answer is being prepared to the wonder of the fisherman in Pericles: "Master, I marvel how the fishes live in the sea."

Of the many plans for propagation, the wave hatching-box may be described. A rectangular box, 32in. long, 17in. wide; depth, 16in.; float, 3in. wide. The box has a wire-cloth bottom, and openings covered with the same material on the sides. Just below these, on the outside of the box, are wooden slips, which serve as floats for holding the box in the proper position in the water. The box is employed in open streams for utilising currents caused by the action of the waves. When placed in the water it sinks to such a depth that the floats which extend round

its exterior rests upon its surface. The upper portions of these floats make a slight angle with the surface, so that each wave as it comes in contact with the float runs up a slight incline, and after reaching the highest point passes down into the box, thus giving a circulation and the best possible motion to floating eggs. The eggs of pollack (*Gadus pollachins*) have been likewise artificially treated in the United States. Although they float similarly to those of the cod, they are smaller and appear to develop more rapidly, hatching at most in five or six days with water of the ordinary temperature. A 23½lb. fish had over 4,000,000 eggs, and a 13lb., 2,500,000.

Haddocks' eggs were hatched in eight or nine days in a floating box.

Herrings' eggs adhere to any substance they are first brought into contact with; consequently they should at once be placed in the situation it is proposed they shall remain until hatched. Up to now the young placed in artificial hatcheries have been found to die after the absorption of the yolk sac. Mr. Oldham Chambers, it may be said, exhibited at the Fisheries Exhibition an apparatus for hatching deep-sea adhesive eggs, such as the herring, consisting of an oblong box about 5ft. in length, 2ft. in width, and 1ft. deep, in which are placed screens covered with muslin, upon which the ova are deposited, the sea-water passing through the box.

Under the auspices of the Norwegian Association for the Promotion of Fisheries, an establishment for the hatching of cod and sole ova has been prepared near Arendal, in the Christiania Fjord. It succeeded so well that another hatchery has been established near Christiania. In 1884, some 7,000,000 fish, chiefly cod and haddock, were hatched at Arendal; while the experiments of placing the ova of lobster in hatching apparatus was attended with great success. The artificial reproduction of the sole is being carried on in France, where it commenced in 1881. Since that time the ova of the sole have been regularly incubated with success, notwithstanding the difficulties attending the process.

What New Zealand has done in the matter of fish acclimatization will be found described in the pages immediately following, under the headings of the fish—the subjects of experiment.

BROOK TROUT (*Salmo fontinalis*).

Thus described in America: Speckled trout.—Mouth, wide; teeth, moderate; body, olivaceous, variegated with blackish, with red spots; lower fins usually orange, with black spots and edges; colours, variable; young, barred. A well-known and beautiful fish; in clear brooks, from the French Broad River to the arctic regions.

In 1881 an order was forwarded to San Francisco for ova of the *Salmo fontinalis* by the Auckland Acclimatization Society, but it was found impossible that year to procure any.

Two small lots were subsequently obtained from Mr. Johnson, of Canterbury, but the first was lost through imperfect packing; and the other, although apparently in good condition, hatched out badly. The few fish obtained were liberated at the Western Springs. The Canterbury Society have taken their breeding and distribution in hand, with every apparent prospect of success.

Brook-trout were artificially hatched in the United States as far back as 1851. Most extravagant prices are paid for them in America by epicures. They are peculiar to the American lakes. At maturity they attain a weight of from 8lb. to 10lb. They have become so thoroughly acclimatized in England as to claim admission to the British list.

The Philadelphia State Commissioners write: "The most beautiful game-fish of the State; abundant in the mountains and the Eastern counties; everywhere in clear water. So much has been said, written, and printed concerning this beautiful game-fish that it would seem like gilding refined gold to attempt anything more. Everybody has heard of it; everybody believes it to be the best pan-fish in the world; in the essential points of flavour and solidity, good keeping qualities, etc., it clearly stands without a rival."

In the year 1882-3 the Norwegian Inspector of Fisheries imported, at the public expense, a parcel of ova of this fish, and the result was so satisfactory in 1885 that one of the hatching establishments near Christiania had 30,000 young fish for sale some two years old.

A recent bulletin of the United States Fish Commission contains, *Nature* says, the following interesting account of the destruction of young trout by mosquitos: "In the middle or latter part of June, 1882, I was prospecting on the head-waters of the Timichie Creek, Colorado. About 9 o'clock in the morning I sat down in the shade of some willows that skirted a clear but shallow place in the creek. In a quiet part of the water, where their movements were plainly discernible, were some fresh-hatched brook, or mountain-trout, and circling about over the water was a small swarm of mosquitos. The trout were very young, still having the pellucid sac puffing out from the region of the gills, with the rest of the body almost transparent, when they would swim into a portion of the water that was lighted up by direct sunshine. Every few minutes these baby-trout—for what purpose I do not know, unless to get the benefit of more air—would come to the surface of the water, so that the top of the head was level with the surface of the water. When this was the case mosquitos

would light down and immediately transfix the trout by inserting its proboscis, or bill, into the brain of the fish, which seemed incapable of escaping. The mosquito would hold its victim steady until it had extracted all the life-juices; and when this was accomplished, and it would fly away, the dead trout would turn over on its back and float down the stream. I was so interested in this before unheard-of destruction of fish that I watched the depredations of these mosquitos for more than half-an-hour, and in that time over twenty trout were sucked dry, and their lifeless bodies sent away floating with the current. · · · From this observation I am satisfied that great numbers of trout, and perhaps infant fish of other varieties, in clear waters, must come to their death in this way."

CALIFORNIAN SALMON (*Salmo quinnat*).

Of this fish, Dr. Hector, some few years since, gave the following details: "This fish has been placed in the sub-genus *Oncorhynchus*, which differs from the true *Salmo* in having more rays in the anal fin. In habits and general form it closely resembles the *Salmo salar* of the Atlantic, and it is probably identical with the North Pacific salmon, *Salmo* (*Oncorhynchus*) *lycaodon* of Pallas.

"The most important difference from the Atlantic salmon is its endurance of much higher temperatures at the period of spawning, as the eggs are matured in the summer and hatched in the autumn of a mild climate, instead of being developed during a rigorous winter, and hatched out in spring.

"The Californian salmon spends the greater part of its life in the sea, and especially frequents deep-water inlets.

"There are three 'runs' of this salmon up the rivers in each year—the first is in spring, during March and April, when the prime fish, of largest size and best quality, after frequenting the estuaries in large numbers during the winter months, start up the rivers, the full-grown fish working up to the source of the streams, where they spawn in July and August. So far as yet observed, the adult fish all die after spawning, and never return to the sea. In August there is a second run of fish up the rivers, but at this season they are of inferior quality. The third run is of smaller-sized fish, in the month of October, just before the winter sets in. There are no salmon in the river during the winter months from November to March, at which season they are caught in the sea.

"The young fish hatch out in October, after sixty days' immersion, when the water has an average temperature of 48° to 50° Fahr., but after forty-eight days' with an average temperature of 58° to 60°.

"It has not been ascertained where the young fish spend the winter months. It is an important fact that in ascending to the breeding-place the gravid fish must frequently pass through river water having a temperature of over 76°.

"The average size of the full-grown salmon in the Sacramento River and its tributaries is about 20lb. weight, but fish weighing from 40lb. to 50lb. are not uncommon. It is a large, handsome fish, with silvery scales, and a deeper body and less delicate look than the salmon of Europe, but in quality as food they are quite equal to it. When in prime order their flesh is firm, sweet, rich, juicy, and high-coloured. As a game-fish they are active and powerful, and are freely caught with hook and line in salt and brackish water. In fresh water the best bait is salmon roe, but they also give good sport with the artificial fly. The climate of the upper tributaries of the Sacramento River, where the best salmon-fishing in California is found, closely approaches that of the New Zealand mountain valleys. The winters are mild, a very little snow falling occasionally with the rains. The days in summer and autumn are hot, but the nights are cool, there being a great range of temperature in the twenty-four hours. Thus, in September (corresponding to March in New Zealand) the thermometer has been known to rise from 55° at sunrise to 100° at noon."

There are various opinions as to its quality as a food fish, but a decision can be arrived at by any person who chooses to judge of it in a canned state, as it is more easily found than our canned mullet in the New Zealand market. Sir Rose Price writes: "Having killed and eaten salmon in almost every part of the world they inhabit, California included, I hope I shall not be considered presumptuous in giving a tolerably decided opinion as to their relative merits, and have no hesitation in saying that the best breed of salmon I have ever met with is our own, and the worst the Californian." They are, however, authoritatively described as the most productive of all migratory fish; as thriving well in varied temperatures, having extraordinary vital powers, and able to sustain life under circumstances that would kill half our European fish. A few years ago only a limited number were found in the Columbia River; but in 1883, by aid of pisciculture, the annual returns from their sale exceeded 1,000,000 sterling.

No excuse is needed for urging the importance of fish-culture on the attention of the public and the Government. The Pacific salmon fishery ranks third in importance among the fisheries of the United States. While the cod fishing yielded $4,000,000 to the fishermen, the Pacific salmon fishery yielded $3,389,000. [The figures are those of 1880.] This Pacific salmon industry has sprung into life during the last twelve years. The chief

rivers which support the fishery are the Columbia and the Sacramento. The Columbia, in 1880, produced 1,925,000 fish, weighing 35,500,000lb. The Sacramento yielded 606,000 fish, weighing 10,000,000lb. The brain grows giddy in attempting to grasp the vastness of the outline even of these figures, and a laudable cupidity arises involuntarily with the remembrance of the present and future supply of Australasia with canned fish. The large majority of the fish thus taken are sold to the canneries, which, in 1880, turned out 655,676 cases, containing 31,453,152lb. tins. Mr. Browne Goode says that though the capture is enormous, it has been demonstrated that the supply can be kept up by a small outlay in artificial culture. The same writer says that the proper function of public fish-culture is the stocking of public waters with fish, in which no individual can claim the right of property.

An individual experience may perhaps prove of general interest. Some twelve years since a gentleman built a cannery on the Sacramento, but he found the river was so exhausted that he could obtain no adequate supply of fish. He closed his factory and left the district. Three years afterwards he heard that his old factory was opened by another, so the following year he went and built a cannery himself; and there were, in 1883, no less than fifteen canneries on the river, all obtaining all the fish they required. In 1883, on certain days, 30,000 fish were thrown away, as the fifteen canneries, already working up to their full strength, had no room for them. Mr. Earll is the narrator. This result had been achieved by the opening of a hatchery on the McCloud, a tributary of the Sacramento, by Mr. Livingstone Stone, in 1872. In eleven years after the salmon hatchery had been in operation, 67,000,000 eggs had been taken and distributed. Mr. Browne Goode says that the produce of 15,000,000 eggs—say, 12,000,000 salmon—were in eleven years turned into the Sacramento and its tributaries. In other words, that 1,100,000 fish were annually turned into the river. But, he adds, the official report of the International Fisheries Exhibition says that the catch has been increased by 5,000,000lb. a year—or, at 16lb. a fish, the average weight of fish in the Sacramento, by 312,500 fish. *If this inference be correct, two salmon have been caught for every seven salmon turned into the river; and the artificial culture of salmon is the most profitable industry which has ever been devised by man.*

The Columbian salmon fishery is managed in this way, or was in 1881-2: It employed from 5,500 to 6,000 hands; 3,100 Chinamen being engaged in the canneries, while the balance were employed with the boats and nets. At that date the canneries owned 1,200 boats, which were leased, with all the necessary nets and appliances, to the fishermen, many of whom are described as Scandinavians, Finns, Italians, and foreigners generally. The conditions of the hiring are these, or they were such, while

there is no reason to believe that they have been in the main altered: As rent for the boats and tools, one-third of the catch is given to the owners, who buy the other two-thirds at stipulated prices. The price varies according to supply and competition. Thus, according to the statistics of the Portland Board of Trade, the sum paid in 1866 was 15 cents per fish, which had increased in 1881 to 60 cents per fish. Each boat carries two men—a captain and a helper. The former hires the latter; boards him, and gives him a certain sum for each fish caught. The fishermen who own their boats and nets sell where they please, but usually receive the same price as is paid to the men using the cannery boats. The captain of the boat expects to make 100 dollars a month, and his helper 70. The average catch of a boat for the season is put down at 2,000 fish, worth 1,200 dollars, equivalent to 300 dollars a month, of which the cannery owners get 100 dollars.

"When canning began on the Columbia," Mr. Hittell says (from whom these details are obtained), "the fishermen supposed that they could not get a good catch save in that part of the river 20 miles or more from the sea, where the stream was not more than 1 mile wide and at a distance of 20 miles or more from the river's mouth. There all the early canneries were built, though the later ones were founded lower down, as when the fishermen allowed their nets to float with the current they found the catch continued equally good, even after the river became 6 miles wide at the ocean. Nor do they," our informant adds, "always take up their nets when they reach the mouth, but sometimes go out to sea for miles, although the bar of the Columbia is dangerous and stormy.

"In the canneries about 850 white men are employed as superintendents, clerks, foremen, etc., earning from 50 dollars to 175 dollars a month, averaging 62 dollars. White men make the nets, cans, boats, and cases, and have all the capital used in the business. The 3,100 Chinamen receive 372,000 dollars for their work of four months; the 850 white labourers in the canneries receive 210,000 dollars; the 2,500 fishermen, 850,000 dollars. The wages in the fishing season and cost of fish paid by the canneries amount to 1,433,000 dollars, and of this the 4,000 Chinamen get less than a third, while the 3,500 whites divide the other two-thirds among themselves. The proprietors get 2,750,000 dollars for the produce, leaving them 1,316,400 dollars above the cost of the fish and wages in the fishing season to pay other cannery expenses, interest on the investment, and profits."

The average weight of the Californian salmon after cleaning is 12lb. When taken to the cannery the fish are placed on a long table, side by side, where the head, tail, and fins are cut off, and the entrails removed by a few flashing strokes of a large knife,

in the hands of an expert Chinaman; the average time for each of the large fish being less than half a minute. They pass to a tank of fresh water, where other men take off the scales; in a tank of salt water they are thoroughly washed. A gang knife, with six blades, at one stroke divides the fish into pieces just long enough to fill a can.

The canning of fish in California has proved in all cases a profitable investment of capital, unless incompetence has had the managing control. Fortunes have been made at it with rapidity, and the canned fish has been exported all the world over. From the foregoing details we can easily see how this has been achieved. The capital required for a large cannery in America is estimated at 50,000 dollars.

The salmon in California are taken with gill-nets, seines, traps, and current-wheels, and rarely in salt-water with hooks. The gill-net is from 200 to 300 fathoms long and usually 20ft. deep, with meshes 8½in. long when stretched lengthwise, and 4¼in. on each side when square. A net usually costs 250 dollars, and lasts one season. The material is twine, made of the best linen shoe-thread, and is knit in the winter by the fishermen, all attempts to make the necessary double-knot by machinery having failed. The net, provided with floats at the top and sinkers at the bottom, is stretched across the current and allowed to float with it until a load of fish is secured, the distance travelled being sometimes 15 miles, or, if the fish are very abundant, not one-tenth so far. The net is generally used only at night or in muddy water, for when the fish can see clearly it will not put its head in the noose. The large fish—those weighing more than 8lb.—get their heads through and stick there, their gills holding them fast. The boat passes along the net, which the fishermen lift and relieve of the catch. When a load is secured (from sixty to eighty salmon) the net is taken up and the fishermen start for the cannery.

The seine has smaller meshes than the gill-net, and is used to surround the fish and haul them to the shore. One end is held on the bank while a boat pays out the seine, which is then swept through the water against the incoming tide for a little while, and then the boat comes round with a sweep to the bank below, and the end is hauled in. While two men can manage a gill-net, a dozen are required for a seine, though the latter is only half the length of the former. Seining is not successful when the water is much deeper than the seine, and it is used chiefly at shoal places in the Lower Columbia and in the Rogue and Eel Rivers. The trap is a picket-fence near the bank in shallow water leading to a pocket, which the salmon swimming up stream enter and cannot leave. The amount of the catch depends on the currents, which

change from year to year, a trap being very profitable in one season and yielding nothing in the next. The average catch of a Columbia River trap in 1881 was about 3,500 fish.

The salmon-wheel is suspended over the water and driven round by the current running under it and striking its lower edge. Attached to it are two scoop-nets which catch the fish passing beneath, lift them up out of the water, and throw them into a trough. Only one such wheel has been constructed near the Cascades, but it has been very successful in the season of 1881, catching from 1,500 to 4,000 adult salmon in a day. This device has been patented. It must be stationed near the bank, but the salmon usually avoid the middle of the stream, where the downward current is stronger, and there are no eddies to facilitate their ascending course. The wheel has caught small as well as large fish, and the fishermen generally demand that its use shall be prohibited.

The boats used in the fishery are uniform in pattern and size—24ft. long, 6½ft. wide, and 2½ft. deep, sharp at both ends, with a centre-board, a triangular sail, rowlocks and oars, and capacity to carry 4 tons. The cost is 250 dollars to 300 dollars, and the period of service about ten years.

Viewed from a commercial standpoint, there is little doubt but that the successful acclimatization of the Californian salmon, in the rivers of Westland alone, is a matter of as great importance to the welfare of New Zealand as the development of her gold-fields or the opening up of her coal measures.

Of our success in the acclimatization with the *Salmo quinnat*, there is not a great deal to say. In 1875, Mr. J. D. Ormond, acting on behalf of the Napier Society, obtained a consignment of ova, which arrived in Auckland in good condition; but the ice had been exhausted for some days (to quote the report of the Auckland Acclimatization Society), and, as it was impossible to obtain a fresh supply between the arrival of the mail steamer and the departure of the Napier boat, it was arranged that one-half of the importation should be left with the Auckland Society. The 20,000 ova sent to Napier were lost; of the 20,000 left in Auckland, 10,000 were at once placed in the upper tributaries of the Thames and Waikato by Mr. J. C. Firth. The remainder, with the exception of a small parcel forwarded to Taranaki, at the request of the Hon. Major Atkinson, were treated at the society's fish-house. The society purposed liberating the fry as soon as they were considered fit to bear removal, and 1,450 were forwarded to the Thames, Wairoa, and Tauranga districts; but the loss in transit was so great that the plan was abandoned. The remainder of the fry was retained for some further period in the Domain. According to Mr. Arthur, only 500 fry were dis-

tributed by the acclimatization societies in 1875. The next year 250,000 ova were imported, and 80,000 fry were distributed in the Provincial Districts of Auckland, Hawke Bay, and Canterbury. Some 42,000 ova were placed by Mr. Firth in the Oratea and Rapurapu streams. Of the 20,000 hatched in the Auckland Domain, 10,000 were put into the Waikato River and 5,600 in other waters. Whakatane had 1,000 fry, but they were lost in transit, and 3,400 died before the absorption of the sac. During 1876 and 1877, there were liberated in Hawke Bay 43,845 fry, respecting which Mr. Williams wrote in May, 1880: "The rivers in which the salmon were placed are many hundreds of miles in length, and all take their rise in a wooded, broken, uninhabited country. It is, therefore, scarcely a matter for surprise that no fish have been seen up to this time."

In November, 1877, eleven boxes of ova arrived from San Francisco by the mail steamer, which were duly distributed throughout the Colony. Of these, 100,000 were placed at the disposal of the Auckland Acclimatization Society, and were deposited in the manner following: 40,000 in the Puniu, 8,000 in the Thames, 7,000 in Wairoa North, and 43,000 in the Mangakahia. About 95 per cent. are said to have hatched out. In 1878, an order was forwarded by the Auckland Acclimatization Society for 100,000 ova to the United States Fish Commission. The society's report says: "Double the number asked for was forwarded. · · · The consignment arrived in very fair condition. It had been intended to divide the ova between the Northern Wairoa and Thames Rivers, but as the consignment arrived a month earlier than expected, and before preparations were fully made, it was found impossible to carry out this programme, and, with the exception of one box retained for hatching in the Domain fish-house, the whole of the ova were deposited by Mr. Firth in the tributaries of the Upper Thames."

Several shipments of ova came direct from America to the General Government, the distribution of which it is difficult to trace. Some young fish were turned out in the Hutt River, 7 miles from the sea; in the Manawatu Gorge; in the Wanganui and Wairau Rivers; but, except two doubtful fish in Wellington Harbour, nothing has been seen of them. So wrote Dr. Hector in 1880. *The West Coast Times*, of October, 1879, reported that the Chinese white-bait fishermen had been taking large numbers of young salmon in the Hokitika River; and fish of the same kind were said to have been caught in the Grey River, in 1880, but both reports require confirmation. In December, 1877, there were 25,000 young fry put into the Wairau and Motueka Rivers in the Province of Nelson, but in May, 1880, the Nelson Society reported the experiment a failure. In 1878, 500 young fish were received in Marlborough, but in 1880 nothing was known of their fate.

In 1876 and 1877, in Canterbury, about 80,000 ova were hatched, and 65,000 parr liberated in different Canterbury rivers. In July, 1880, the Cam, a branch of the Waimakariri, was netted, and three salmon were got, from 5lb. to 8lb. in weight. The evidence as to the catch and to its character seems complete.

A box containing 50,000 ova was presented to the Otago Society by the Government on November 7th, 1877. For the first four days many ova died, but others began to hatch, and this operation was completed in a fortnight; only 15,000 fry, however, were estimated to be the result. Of these, 2,000 were deformed and died, and the 13,000 survivors were put into the Kakanui River in January, 1878, being very vigorous and about 2½in. long each. Nothing positive has since been seen or heard of them.

In 1876-77, Mr. Howard liberated in Shag Creek 3,600; in Winton Creek, 1,200; and Irthing, 12,800; these streams being tributaries of the Oreti River. In the season 1877-8, he put into the Oreti River 35,000, in the Makerewa, 18,000; and in the Waipahi, 10,000. In February, 1878, Dr. Hector liberated about 500 healthy young Californian salmon in Revolver Bay, Preservation Inlet. In the Otago Acclimatization Society's report for 1883 the following is found: "This salmon, although it was introduced into our rivers five years ago, has not since been heard of."

In the same year, in the report of the Canterbury Acclimatization Society, appears the following: "Reports have reached your Council from time to time that salmon have been taken in different streams. A sketch from actual measurement of one of these fish was made, and minute details of fins, etc., noted, and sent to Professor Baird, Chief Commissioner of Fisheries in America, who procured the opinion of Dr. T. H. Bean, Icthyologist of the National Museum, whose conclusion was that the subject of the sketch is certainly a species of *Oncorhynchus*, and, judging from the colour of the flesh, the number of anal rays, and the stoutness of the body, there is little doubt that it is the *quinnat* species."

It will be noticed from an attentive perusal of the records of our failure in Californian salmon and white-fish acclimatization, and for that matter of the *Salmo salar* as well, that there is no difficulty in bringing the ova of these various fish to New Zealand and hatching them, and developing the fry into young fish; and it is noticeable that, in many cases, as long as they remain under supervision they thrive, and seem likely to do so. But it is not by any means clear that we have any arrangement anywhere in the Colony of retaining in captivity any large quantities of fish after they are fit to leave the hatcheries. It has been found, wherever it has been tried, almost a comparatively easy matter to hatch and to bring on to feeding point large quantities of *salmonidæ;* but

the most serious part of the business is to keep within bounds, and to have at hand a large number of yearling fish. There is little use in hatching fry if they are not reared. If the young fish can be kept through the first year in safety, most of the dangers they are liable to will have passed outside of them. It is simple waste of costly fish-life to import ova from another hemisphere, to hatch them, and then turn the fry adrift to feed the voracious fish with which our waters abound. We have learned how to hatch fish in large numbers, but not how to breed them in appreciable quantities. We have no appliances for so doing, and the consequence is that, as the fry increase in number, they are turned out and allowed to run the gauntlet of all the ills that young fish are heir to in our streams and lakes. It is the gulf between the fry losing its sac and the yearling fish that requires bridging; and, so far as the Californian and British salmon are concerned, no efficient attempts have been made in New Zealand to do so.

It is plain that some other means must be adopted with these varieties of the *salmonidæ* if success is desired to be achieved. The acclimatization societies have tried their best endeavours and failed. The task was too great for them. It was one the Government should have taken upon itself. The late Mr. Buckland advised that the young fry of the *Salmo salar* should be retained in captivity for six months at least, and then placed in a well-watched piece of water, best adapted for their growth, with a grating or other means adopted for preventing their escape down stream. But Mr. Fryer further proposed that they should be kept there for another eighteen months, after which they should be transferred to the sea-shore, and placed in a similarly protected spot in the sea. It might be possible to carry out this arrangement in some small arm of the sea, where they could find sufficient food, where they would be protected from predaceous fish, and where they would become mature enough to develop spawn. However, the safer plan, he said, would be to place the smolt in a large marine aquarium, with a constant supply of well ærated water, and with food such as shrimps, the *infusoria* naturally found in the sea-water, etc. In such an aquarium the fish would thrive and become sufficiently developed to produce spawn. When the time comes, they might be transferred to the river to perform their natural functions in the ordinary way, or the spawn might be artificially taken from them, impregnated, and treated in the same way as the eggs from which the young fish now living were produced. If such an experiment were successfully carried out, thousands of ova would be at once available in New Zealand, without the necessity of shipping them from England. It will be evident that only the Government could undertake such an experiment as this; and until some such an one is tried there seems little hope or chance of our knowing whether the Californian

salmon, British salmon, and white-fish will live in our waters or not. To the present time we are almost as ignorant on this matter as we were thirteen years ago, when Mr. Fryer wrote the foregoing advice.

In the report of the California State Fisheries Commission, for 1877, we are told that "The *Salmo quinnat* readily adapts itself to a life in fresh water, and reproduces its kind where it has no opportunity to go to the ocean. When the dams were constructed on the small streams that go to make the reservoirs of San Andreas and Pillarcitos—which supply the City of San Francisco with water—as also when the dam was constructed on the San Leandro, to supply the City of Oakland, the young of the salmon that had spawned the year previous to the erection of these dams remained in the reservoirs and grew to weight, frequently as much as 10lb.; these reproduced until the reservoirs have been stocked. As the supply of fish increased, the quantities of food lessened, so that the salmon have gradually decreased in weight, until now, after nine years, they do not average more than 2lb. From the fact that, when the food was in abundance, they grew to weigh from 8lbs. to 12lbs., and that, as they increased in numbers, they averaged less in size, but still continued to spawn and produce young fish, it would seem that the Sacramento salmon may be successfully introduced into large lakes in the interior of the continent, where, in consequence of dams or other obstructions, they would be prevented from reaching the ocean. The history of this fish in these small reservoirs shows that all that is requisite for their successful increase is the abundant supply of food to be found in large bodies of fresh water. Salmon, fully matured, weighing 2lb., and filled with ripe eggs, were taken, in September, 1877, in the waters of San Leandro reservoir. These fish were hatched in the stream which supplies the reservoir, and by no possibility could have ever been to the ocean. The San Leandro is a coast stream, not exceeding 15 miles in length, and empties into the Bay of San Francisco. It contains water in the winter and spring, at which time, before the reservoir was constructed, the salmon sought its sources for the purpose of spawning. There was never sufficient water in the months of August or September to permit the fish to reach their spawning grounds. After the construction of the reservoir, large numbers of the salmon that came in from the ocean in January and February were caught at the foot of the dam, and transported alive and placed in the reservoir above. The descendents of these fish thus detained in fresh water, and not permitted to go to the ocean, have so far modified the habits of their ancestors that they now spawn in September, instead of in January and February. Inasmuch as these fish spawn in the McCloud, in the headwaters of the Sacramento, and at the sources

of the San Joaquin, in the Sierra Nevada, in September, and in short coast-range rivers in January and February; and as, when changed to other waters, their eggs ripen at a time when the conditions of their new homes are most favourable for reproduction, they show a plastic adaptability, looking to their future distribution, of much practical as well as scientific importance."

Looking at the many advantages that would result from the acclimatization of *Salmo quinnat* in New Zealand, one cannot but repine at our repeated failures.

CALIFORNIAN, OR MOUNTAIN TROUT (*Salmo irideus*).

Form, stout; head, short, rather blunt; mouth, small, the maxillary bone scarcely reaching the eye; fins and tail, black, spotted; a few small black spots on the back and ribs; sides and belly, rosy, red, or silvery.

The American brook-trout were introduced in Auckland in 1877, in the form of 5,000 ova. Only 400 came to life. Half of the fry were put into a tributary of the Waikato, near Cambridge, and the remaining 200 into the head-waters of the Kaukapakapa stream, in the Kaipara district.

Two consignments were received early in the autumn of 1883. From 4,000 to 5,000 young fish were hatched, and distributed in six localities in the Auckland Provincial District. A small number was retained in the Domain ponds for breeding purposes. In 1884, another shipment of 30,000 ova was received from San Francisco, but they were all dead on arrival.

This year (1886) the Auckland Acclimatization Society decided to liberate a number of the young of this fish in various streams in the provincial district.

The State Commissioners of Fisheries of Pennsylvania say: "Among the various fishes of our own and foreign countries introduced into Pennsylvania from other localities, there is no one that has given such rich promise of complete success or so much general satisfaction as the *Salmo iridea.* There are a number of reasons why this species, which we shall call the 'rainbow,' have won their way so rapidly and fully into public favour. One of the principal of these is that it will live and thrive in waters in which our native brook-trout would quickly perish. It will stand a temperature of 75°. It is admirably adapted to minor streams, the currents of which are rapid and the waters pure. It is of much quicker growth than the brook-trout, and in point of vigour and strength far superior to it. In their native waters they spawn in March, but their spawning time in hatcheries varies from December to the previously-mentioned date. It bears rough handling and transportation well. They are difficult to 'strip'

without injury, being so strong that it is almost impossible for one man to hold them. Unless stripped at the proper moment there is considerable difficulty in extracting the spawn. Few other fish take the fly as readily, though grasshoppers and other live insects are almost sure lures. It is rarely attacked by fungus, which frequently happens from bruises which the fish sustains."

CARP (*Carassius vulgaris*).

The carp was one of the earliest fish introduced into the Colony. During 1867, 114 were obtained by the Auckland Acclimatization Society, of which twelve were placed in the Takapuna Lake. They came from Tasmania. Since then they have been widely distributed, and now many of the lakes and ponds in New Zealand abound with them, more especially Lake Taupo, where they are found in large quantities. The carp are good fish for a pond. They breed often, and largely. The young are hardy, and grow rapidly. The male is mature in five years, but the female not until she attains the age of eight years. A female carp weighing from 4lb. to 5lb. contains, according to Mr. Hessel, between 400,000 and 500,000 eggs. In employing carp as food fish, Mr. Day says great care is desirable in selecting the race which is going to be imported. In Germany and elsewhere there are three varieties which are cultivated—the common carp, the mirror-carp, and the leather-carp. Of these three species the mirror-carp is considered the superior, being the most hardy form, and bearing up best against injuries. Some fish culturists make a speciality of raising forms possessing very few scales. Sometimes these are restricted to a single row along the lateral line, or a strip along the back. Crucian carp (*Carassius vulgaris*) will cross with this form. The crucian and gold carp should not be permitted in the same ponds as the common carp. It is necessary to bear this fact in mind, as some details are given of the common carp, to the culture of which it is desirable to draw attention. It will prosper in almost water of any temperature, in which scarcely any other food fish could live or thrive. While it stands the heated water of pools, it delights also in flowing streams where the water is cool, provided the current is not too strong. But, as the report of the State Commissioners of Pennsylvania, for 1884, remarks, the most notable recommendation of the carp is that it is possible for almost any farmer to have a fish preserve of his own, in which he can grow fish for his family with less cost and trouble than he can chickens or turkeys. In France, carp culture is carried on in a profitable manner, as the following description, taken from a London newspaper, will show. The *Saturday Review* says:—

"The carp culture in the highlands of Central France is a form of industry which merits a good deal more attention and

imitation than it has hitherto obtained. On that high plateau there are ponds of all sizes, some of them large enough to be dignified by the more grandiloquent name of lakes, but to the country people they are one and all *étangs*, and nothing more. These ponds are one of the chief sources of wealth of the country, which is mostly but poor soil for cultivation, as a great part of it has only recently been reclaimed from moorland and heather. These ponds are stocked with carp, and once every three years a great fishing takes place. All the able-bodied men of the country-side are engaged for a certain day in October to meet at one of the ponds; that on the highest level being taken first. The sluices of the pond are opened three days previously, and the water allowed to run gradually off, leaving the bed of deep mud which seems to be one of the necessaries of carp existence. When there is only a thin rill of water left trickling down the centre of the erstwhile pond, the fishing begins. On all sides the carp lie floundering, panting, gasping on the expanse of mud; in some places the fish are two or three deep on top of one another. The number of carp in these ponds is something quite extra-ordinary; they do not seem to suffer individually from their great numbers, for the fish are remarkably fine and heavy. The men wade through the mud, catching hold of the carp by the gills, and flinging them on to the bank. There they are weighed by men who have come with carts from the nearest town to buy the fish; and, after the weighing, the carp are packed amongst straw in the carts as tightly as possible. When the carts are full they return to the town, and the carp are then placed in tanks. A carp takes a good deal of killing; and though being tightly packed in straw for a whole day, and jolted down hill for perhaps four hours, may strike him as a novel experience, it does not do him the very least harm; and as soon as he is released from durance vile and placed in the tanks he resumes the even tenor of his way, probably till the following Lent, when, as *carpe au bleu*, *carpe en matelote*, *carpe au vin blanc*, and in many other still more savoury disguises, he helps the faithful Catholic through his forty days' trial. While the fishing goes on, groups of women make fires on the bank, on which they heat cauldrons of soup, mixed with strong red wine, which is served out unceasingly in bowls to the soaked and muddy fishermen. This is a necessary precaution in a climate where people are sometimes snowed up for days early in November. The gipsy fires and groups of women; the men wading through the mud and water, mostly dressed in frieze coats of the most brilliant hues, and with high boots on to protect them somewhat during the task; the piles of shining, glistening fish; and, in the back ground, the carts waiting to take away the spoils, altogether make a scene highly picturesque and one likely to remain in the memory. Amongst the carp are always found a number of

pike—one of the mysteries of pisciculture—for the very greatest care is taken to eliminate them from the ponds on account of the immense damage they do. As the ponds are drained dry and completely restocked every three years, one would imagine that the extermination of the pike would not be a very difficult matter; but when the triennial fishing takes place the irrepressible pike is again to the fore. As soon as the fishing is over in one pond, the sluices are closed, and the pond allowed to fill gradually, while the fishermen betake themselves to any other ponds that are to be fished the same year, according to the date of their restocking. When the empty ponds are again full of water, the breeding-pond is drawn upon to supply young fish. This breeding-pond is never drained dry of water. When young fish are required the breeding-pond is drawn with nets, and only young fish are taken; the old ones are returned to their home to breed undisturbed, while their progeny are translated to the fishing-ponds for their allotted span of three years.

"Of the profit to be derived from this form of pisciculture, some idea may be gathered from the fact that half-a-franc a lb. is the price given for the fish when weighed on the bank of the pond in which they have been caught. There is no expense in seeking a market, with possible loss on the fish by the way—in fact, no expense of any kind except the pay of men and boys employed in the triennial take, which is but a small item in comparison to the enormous profit on the hundreds of heavy fish which have cost absolutely nothing up to the time of the sale. It is no wonder, therefore, that the landed proprietors in the Department of Correzé consider that the acres under water are infinitely more profitable and far safer investments in every way than those under agriculture. We islanders are too apt to think scornfully of any fresh-water fish except trout, but the French can teach us as much in this part of the great question of food supply as in the others. It has often been said that a Frenchman will live succulently where an Englishman will nearly starve; and when we see all our ponds and inland broads lying unused, and their capabilities of supporting and fattening fish wasted, we must feel in all humility that our French brethren make a better use of the bountiful gifts of nature than we do."

Rapidity of growth is a marked characteristic of the carp. It grows four times as rapidly, it is said, as the trout. It is not merely long-lived, but grows to an enormous size, attaining, it is declared in one case, a weight of 90lb. It is nearly omnivorous. It will live on purely vegetable food, though, when opportunity offers, it will not hesitate to take a grub, a worm, or even a fly. The larvæ of aquatic insects is a toothsome morsel to it. Where it is necessary, as is sometimes the case, to feed them—as where the

amount of vegetable matter on which they feed is not sufficient to afford vigorous sustenance—offal from the kitchen, refuse from the slaughterhouse, curds from the dairy, or anything that poultry will eat, will be accepted and partaken of with relish.

The ova of the carp is generally deposited on water plants, and hatch out in from fourteen to twenty days. Its quality as food depends largely upon the water in which it has lived. If the water has been impure, the flesh will partake of its unpleasant taste; but this can, in most cases, be removed by placing the fish in pure water for a week before it is to be killed for use. Carp immediately before or after spawning are not fit to eat.

The Rev. Mr. Tenison-Woods says that artificial carp ponds, which are made by a dam, should cover 10 or 12 acres at least. The sides should be steep, except on one side, the depth over 7ft. or 8ft., not only to allow for evaporation, but also to prevent its becoming clogged with a growth of weeds from the bottom. There should be waste weirs at each end of the embankment for flood-times. The pond may be divided off by an embankment below the surface, so as to portion off a shallow breeding-place.

In America the carp is conveyed long distances in well-boats, through which water is allowed to pass; and, from experiments made, it appears that it can be transported in railway-vans where only sufficient water is sent that will cover its back, and it has been thus carried for nearly four days without ill effects. To improve their flavour, Mr. Tull castrated them, as he asserted, with excellent effect.

In 1877, the German carp was introduced into America by the United States Fish Commission. These were placed in ponds especially prepared for them, at Washington and Baltimore. In 1880, the distribution of fry began, and up to 1st January, 1883, the carp had been planted in no less than 17,860 localities. They prove to be specially adapted to their surroundings, and in some localities they grow with surprising rapidity. A fish, 4in. long, placed in the waters of Texas, was found to have increased to 20½in. in eleven months, at which time it weighed 4lb. 11oz.

CAT FISH (*Pimelodes Cattus*).

The cat-fish (*Pimelodes Cattus*) was obtained in 1877 by Mr. T. Russell, from America; in all, 140 living fish arrived, and these were placed in St. John Lake. This fish is esteemed good eating, and may be caught with hook and line. *Land and Water* says: "Considerable attention has been paid to the distribution of this species in the United States. It is said to do well in

small lakes, ponds, and mill-dams; to be good eating, and easily caught." They have increased to a large extent in lakes near Sacramento, and have formed an important addition to the food supply of that city and its vicinity. In the Auckland Acclimatization Society's report for 1885 we are told that, although the fish after liberation were lost sight of, and it was supposed they had died out, during the present summer they have reappeared in considerable numbers, and are evidently increasing fast. They are as hardy as the carp, and as profitable to cultivate; they are far preferable as food, and nothing can be said against them but their looks.

The cat-fish has been introduced into Great Britain, and *Nature* describes it as a very valuable food fish that will assume a high rank among the fresh-water fishes of England if cultivated.

CHAR (*Salmo umbla*).

Of this fish, 1,000 ova were presented to the Otago Society, and arrived in the Timaru in April, 1875. Of these, 300 hatched out at the ponds (Otago). From a growth on the umbilical bag many died, and of the twelve left at last, the whole lot escaped, and disappeared in the Opoho Creek. Such is the record of our attempt to acclimatize a fish of the same genus as the salmon, common in Britain and in the lakes of the Continent of Europe. It is celebrated as the *ombre chevalier* of the Lake of Geneva. It is generally under 1lb. in weight, though sometimes it is found weighing more than 2lb. Chambers says that while it is the most delicious, perhaps, of the *salmonidæ*, it is also the most beautiful; its rich purple, rosy, and crimson tints, and white spots, rendering it a brilliant and striking object. During summer the char haunts deep, cool water, and is seldom seen at the surface till late in autumn. It feeds on insects and minute crustaceans. At the end of autumn or beginning of winter it ascends the rivers to spawn, always choosing those which have a rocky bottom. Whether in lake or stream, it is only to be found in clear waters. On some lakes vast quantities are caught for the table, particularly for the purpose of potting. They are fast diminishing in English waters, owing to the wholesale slaughter which occurs at the spawning season. There should, however, be no difficulty in obtaining char ova, as at Sir James Maitland's establishment, in 1883, upwards of 156 gallons of trout and char eggs were collected, while over a million fry, beside 2,900,000 eyed ova, were distributed. The general computation of ova, in Scotland, to the gallon is—salmon, 24,000; Loch Leven trout, 30,000; brook-trout, 40,000; American brook-trout or char, 80,000.

PERCH (*Perca fluviatilis*).

Twenty-one perch were got from Tasmania, in 1868, and were put in the Water Company's reservoir, Dunedin. They have thriven so well that numbers have during succeeding years been transferred to various lakes and lagoons, at the Waihola and Wakatipu Lakes, and lagoons at Tomahawk, West Taieri, Clutha, Gore, etc. A later report says: "These fish do well wherever in Otago we have put them." "A quantity," Mr Brewer writes, "were obtained from Hobart Town by the Canterbury Society, but from some cause unknown they did not do well in the Gardens, and the few left were turned out to give them an opportunity of propagating their species. A very successful importation was, however, lately made by myself of fifty dozen from Ballarat, Victoria. They arrived in splendid condition, and were all turned out in suitable places. The Ballarat lake swarms with them, and they attain a weight of 3lb. to 3½lb. They are the produce of about a dozen fish which were turned out there some fifteen or twenty years ago."

In the report of the Wanganui Acclimatization Society for 1882 we learn that there are ponds in the district which are now well stocked.

In Canterbury, perch were obtained from Hobart Town prior to 1877, but, not thriving well, were turned out into the Heathcote River, and probably into other streams, as Mr S. C. Farr wrote in January, 1884:—

"In March last Messrs. Gould, Oakden, and myself arranged a day for perch fishing in the Ashburton waters. On our arrival at the Ashburton railway-station we were met by Mr. Shury, who accompanied us to Mr. Hunt's farm. The result of our fishing was about seventy perch, which were brought to the Gardens, and eventually disposed of in different waters where it was considered they would do well, and there is every reason to conclude that this effort has met with success. In May another lot of about 100 was caught by Messrs. Oakden, Shury, and myself in the same streams, and distributed in the same way as the first lot; and in October we were successful in collecting a quantity of spawn at the same place. This was turned into one of the ponds at the Gardens, but of results there is nothing certain. Still, with the number we have in our ponds there will be ample for breeding purposes, so that in a very short time all available waters in the district will be amply stocked. This probably will be better understood if I here quote from Dr. Buckland's *History of British Fishes*, in which he has written: 'Dr. Norman sent me two fine perch in April, 1868, caught in Norfolk Broad; they weighed respectively 3lb. 2oz. and 2lb. 11oz. Wishing to know the number of eggs they contained, they were counted by myself and Secretary; we found that they amounted in the larger one to 155,620; in the smaller, 127,240.'"

The perch, as is generally known, inhabits lakes, ponds, canals, and rivers, more especially frequenting deep holes or where there is a gentle current, preferring the sides to the more rapid parts of the streams. Occasionally it will descend to salt water, and when found in such localities, or where the water is brackish, it is highly esteemed. In muddy ponds, as may be expected, it loses its flavour. Being very fond of fish fry, it is not an advisable form in salmon or trout waters. At its third year, and when about 6in. in length, it commences to spawn, depositing from 20,000 to 28,000 ova. It seldom exceeds 3lb. in weight.

"The eggs, which hang together in bands like rows of beads on a coral necklace, are very small at first, but gradually swell, and the young fish escape in from ten to twenty days, according to the temperature of the water. The eggs are deposited on water-plants and submerged boughs, and are then fertilized by the milt of the male fish." Thus far Mr. Marston; when Mr. Day comes in, telling us of the Macdonald Egg-reel, an American invention for dealing with adhesive eggs, the mucus of which hardens under water. The eggs are taken upon cotton yarn, which is drawn up through a funnel, into which the milt and eggs had been squeezed from the spawning fish. The thread, covered with adhering eggs, is rolled upon a wooden reel and sent in damp cloths to its destination. On arrival, the cotton cord is cut into lengths of 10in. or 12in. and suspended in glass hatching-jars.

But the simpler plan for our surroundings would be the use of Lund's hatching-box, which is thus described: It is simply an ordinary box, its size depending on the number of fish it is to hold, with holes drilled in the sides to permit of a free current of water through it. The interior is lined with fir branches; and in Sweden, where it has been in use for over a century, it is thus used: Shortly before their spawning time a few pairs of male and female fish (perch are principally cultivated in this way) are placed in the box, which has previously been anchored in a pond, lake, or stream. The water is not allowed to flow over the top of the box, which is kept some inches above the water level. The box either rests on the ground, or by means of wooden floats is kept at a proper level. The parent fish deposit their ova on the fir branches, and they are then taken out. In a few days the young fish hatch out and are found in millions among the branches. They can then be either liberated in the lake or other water they are in, or transported to some other water it may be desired to stock, or the fecundated ova can be transported in the same way. Here, then, we have a most simple and inexpensive way of obtaining any quantity of that most valuable fish, the perch. The box ensures that the incredibly vast number of ova deposited by a few fish are protected from the numberless enemies

which would attack them in the open, even supposing that the parent fish had been able to find a suitable and undisturbed place in which to deposit them. It is simply aiding nature, for the whole operation goes on exactly as in the ordinary way. Sun, air, wind, and waves can exert their beneficial influences, while the ravages of storm and flood are provided against. M. Lundeberg, the Swedish Inspector of Fisheries, says that, although used chiefly for perch, they can, with slight modifications of the material on which the spawn is to be deposited, be equally well used for roach, bream, and some other fish.

Perch breed so fast that, if care is not taken to keep their numbers within bounds, they will soon overstock a pond. Pennant tells us of a perch taken in the Serpentine that weighed 9lb. According to Professor Owen, the milt and the roe are single in the different sexes. Perch, we are told, have a most remarkable capacity for living out of water for a considerable period, a fact which adds greatly to their commercial value. In some parts of Germany perch are carried alive to market, sometimes a distance of 40 or 50 miles, and, if not sold, brought back to their tank or pond to await another occasion for sale.

SALMON (*Salmo salar*).

The history of the attempts to introduce salmon into New Zealand waters needs not to be related in detail. Here, fish-culture has largely been in the hands of acclimatization societies, and controlled by detached efforts. Otago appears to have made the first movement, as in May, 1864, Mr. Macandrew moved. in the Provincial Council, that an address be presented to his Honor the Superintendent to have placed on the estimates a sufficient sum for the purpose of introducing salmon ova into the rivers of the province; and on June 2nd, of the same year, a vote of £250 was carried for that purpose. In 1864 the Otago Acclimatization Society was founded.

In 1867, when Superintendent of Otago, Mr. Macandrew wrote to the Executive of Tasmania to learn if Otago could be supplied from that Colony (where the experiment of salmon acclimatization was supposed to have succeeded) with salmon ova. The Tasmanian Government very cordially responded to the application, but it was found that it was quite uncertain how far they themselves had succeeded, and Mr. Macandrew determined to get ova direct from the United Kingdom, and £1,000 was voted by the Provincial Council for that purpose.

The first shipment of salmon ova, numbering 200,000, sent to Otago, was collected and packed under the superintendence of Mr.

Youl and Mr. Ramsbottom. It had been obtained from the Tweed and Tay. Breeding-ponds were constructed on the Waiwera, one of the tributaries of the Clutha River. It happened that among the assets of the Province of Southland—when it became reunited to Otago—there was a model of the Stormontfield Salmon Ponds, and breeding or hatching arrangements, on the River Tay, which served to aid and enlighten those interested in the experiment as to their necessary preparations. The first ova came out in the Celestial Queen, and got to Port Chalmers on May 2nd, 1868, after a passage of 107 days. On arrival the ova was sent round to the breeding-ponds, and 40,000 were put into the hatching-boxes. About 1,500 were reared as far as the smolt stage, when they became greatly reduced in numbers by escaping into the Waiwera, and the depredation of shags. At last the remainder, 250 in number, were turned out into the river, since when no trace of them has been seen. With this shipment there came out a Mr. Dawbin and his wife, in charge, who were located at Waiwera, where they remained.

Otago had three direct shipments, and the province spent some £5,000 on the experiment. The Council voted £120 for a present to Messrs. Buckland and Youl, which took the form of a piece of plate, coupled with a vote of thanks. When the Californian service was first established, with its terminus at Port Chalmers, Mr. Macandrew offered a bonus of £100 to the captains of the boats for each shipment of salmon ova landed in sound condition, but the service was discontinued before any good resulted from the offer.

In 1871 the Auckland Acclimatization Society got a direct shipment of ova from England by way of New York, but nothing came of the effort. Salmon ova then came to the Colony by the way of Melbourne in steamers to the Bluff, and the ventures, Mr. Archer says, were more successful, though one or two were wholly failures. Of the Oberon shipment, ninety-six young English salmon smolts were put into the Aparima, or a pond adjoining it, in 1874. In 1876, of the Durham shipment, 1,400 were liberated in the same river; and of that by the Chimborazo, some details are given by the Hon. Mr. Menzies: "The shipment was 45,000, but was only a partial success. The ova packed by Mr. Youl looked bright and healthy, *but only a portion was fecundated.* They began to hatch on the 4th April, the eighty-third day after shipping; about 250 are already (April 15th, 1878) hatched, and the Curator does not, from present appearance, expect more than 2,000 fish from these boxes. The ova packed by Mr. Buckland were not in such good condition, the greater portion being opaque. They began to hatch too soon. About fifty are hatched, and about 500 more are expected to hatch out." Writing on October 4th, of the same year, to the Colonial

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nay here be expected to the land-locked salmon, nd about which so much has been written; but, nents we have come across, that of Mr. Wilmot, Commissioner at the Fisheries Exhibition, is the attention. In a discussion which ensued on this almon family he said: "His impression was that such thing in existence as land-locked salmon, r naturally. It was the true *Salmo salar*, which had pe from the water it lived in. Land-locked salmon, *Salmo salar*, was a fish which could be obtained by ist at his pleasure; all he had to do was to hatch of the *Salmo salar* a number of little fish, put them ody of water, from whence they could not reach the

Secretary, the Hon. Mr. Menzies says: "The Curator of the Southland Salmon Ponds informs me that he has placed in the Aparima River about 1,700 salmon fry hatched from ova received from England in autumn by the Chimborazo. Of these 300 were hatched from the ova sent by Mr. Buckland, and the remainder from those packed by Mr. Youl. The young fish are healthy and strong, and were removed without loss. You will no doubt remember that this river has been specially reserved for *Salmo salar*, and that about 1,600 young salmon hatched from previous shipments of ova from England have already been placed in it." Mr. Howard, some time afterwards, who had taken great interest in these experiments, went to Riverton to learn aught if he could of how the fish throve, and gave his opinion that there was no proof of the return of the salmon to the river. Of the light in which this experiment was regarded, the Hon. Mr. Menzies says: "The Chimborazo ova have turned out better than any of our previous shipments, there being about 2,500 fry from about 42,000 or 44,000 ova."

The Otago Acclimatization report of the Otago Society for 1883 says: In February last we received a shipment from Mr. C. C. Capel, of the ova of the Tyne salmon, by the s.s. John Elder, but on the arrival of that vessel at Melbourne our Manager, who awaited them, found that they were all dead.

Going North we learn that two boxes of salmon ova, brought from England to Melbourne as part of a large shipment by the s.s. Durham, were obtained by the Canterbury Acclimatization Society from Mr. Macandrew. They came to Lyttelton in April, 1876, but only 175 ova appear to have hatched out, which were placed in the River Ashley in 1878, since which placing they have left no record.

In 1882 we find the Wanganui Acclimatization Society saying in its report: One of the best efforts of the society has been the introduction of the British salmon, the true *Salmo salar*. A consignment of 5,000 ova arrived in fair order, out of which the Honorary Secretary hatched out 4,560 young fish, and safely deposited them some 20 miles up the Wanganui River. As there was no ice available, the result of this hatching may be looked upon as exceptionally good.

At the conference of the acclimatization societies, held in Dunedin, the following sentences respecting salmon introduction are found in the report of the resolutions: As regards salmon in New Zealand waters, we are only as yet able to state that a few specimens of the Californian salmon have been caught and identified in three Canterbury rivers. The British salmon has not shown itself at all in any river. The various reports as to the reappearance of this fish in the Aparima have invariably, on a thorough investigation taking place, been proved to be quite unreliable.

It should, however, be remembered that the return of salmon from the sea to the rivers from whence they were liberated or spawned must not be either too confidently or too hurriedly expected, as observation has proved that the migrations of the salmon are wide and erratic. Thus for the last 200 years the Flemish and Swedish fishermen in the Gulf of Bothnia have been in the frequent habit of finding hooks in salmon they have captured which were made and used in North Germany, showing that on some occasions the hooked salmon had travelled some 15° of latitude after it had succeeded in making an escape from capture. But the element of time is also important in these migrations. On March 23rd and 24th, 1872, a thousand salmon, marked by cutting away the "fat" fin, were let out into the Weser River. The marking was effected by taking the fish in the left hand and then cutting away the fin with a pair of scissors, whereby the fish were uninjured. The little fat fin, which is mostly found on *salmonidæ*, contains no nerve of any importance, and has no particular function. Ever since that year the fishermen between Bremen and Hameln have been on the look-out for the marked fish; but it was not until the month of July, 1884, that one was caught at Osterdeich, just above Bremen, weighing 30lb. The fat fin, which on the fish ought to have been 6 centimetres in length, was entirely absent; and, when the well-healed cut was felt, the hard membrane indicated that an operation had at one time or other been performed at this spot. The fish was marked as a grilse in 1872, when it was thirteen months old. According to general observation, it has been demonstrated that the salmon in the Weser is, when one year old, from 5 to 12 centimetres long. In the second year it has been proved that the salmon go into the sea, and when they re-enter the river at four years of age they weigh from 8lb. to 12lb., and in the fifth year from 12lb. to 15lb. From that age upwards the weight increases rapidly.

At the latter end of 1884, Mr S. C. Farr, of the North Canterbury Acclimatization Society, was sent to England to get a further shipment of salmon ova. He succeeded in obtaining 198,000. He also secured fifty healthy and strong parr, which died on the passage out. In his report to the Colonial Secretary he says: "I need not trouble you with the details of the voyage in this paper, further than stating that with one or two exceptions, and those because it was quite impracticable owing to rough weather, daily attention was given to the ova, picking out dead eggs, regulating temperature of cases with ice, which averaged 34·06° Fahr. throughout the voyage. About 81,000 bad eggs were taken from the trays, leaving 117,000 in a very healthy condition up to the forty-fourth day of sailing, and ninety days after being taken from the parent fish, when, having arrived at Wellington, the refrigerating engine was stopped, and I found

great difficulty in keeping down the temperature; consequently many died. This was not to be wondered at, considering the extraordinary ordeal they had passed through, such as no ova had ever been subject to. Two cases were delivered to Mr. Rutherford for the Napier and Wellington Societies, two for Mr. Edwards for the Otago and Waitaki Societies, and two were detained at Christchurch for North and South Canterbury Societies. Of the actual numbers hatched I have no returns up to date, but will furnish the Government with them when received. In the boxes in the Christchurch hatching we have about 21,000."

In January last some 200,000 ova were shipped on board the Ionic for New Zealand, having been packed by Sir James Maitland himself at Howietown. A chamber had been put up for their safe conduct, adjoining the ship's refrigerator, and two boxes of trout ova were placed in the refrigerator itself in order to afford a test as to whether ova can survive the amount of cold there. The fate of the trout ova is graphically told by Mr. Rutherford. He says: "The sawdust round the inside box was dry, and the box exceptionally well packed. Within, the moss was frozen into a solid mass, the trays all being stuck together, and, on opening a layer, it was evident that the ova had been frozen to death. There was no sign of life, and the appearance presented was like layers of light-yellow, transparent, unfertilized ova, with one side of each egg slightly fallen in. A coating of hoar frost surrounded each egg. The animal matter was in good condition, and what looked like traces of yellow dead fish could be seen in many of the ova." From the papers laid before Parliament, the salmon ova appear to have hatched out well. In some cases the dead eggs only amounted to about 16 per cent. Eight boxes of ova were put into the chamber adjoining the ship's refrigerator, and one was left outside. Mr. Farr describes the condition of the ninth box in his report of the four boxes allotted to the hatchery of the North Canterbury Acclimatization Society. He writes: "Each box contained about 22,000 eggs—total about 80,000. · · · In the box that was outside the cool chamber we found 21,934 dead eggs, and from the other three boxes we took 24,446, making a total of 46,380 which had lost all vitality—if they had ever possessed any, for many were unimpregnated. This large mortality is not at all surprising when the large quantity of fungus, as well as many patches of byssus, that was found among them, is taken into consideration. We succeeded, however, in hatching out 41,420, of which 1,420 have since died, and about 4,000, which I have picked out and put into a large tray by themselves, are deformed (crooked backs) and will die, leaving in our boxes · · · about 36,000 fry." There is no need to enter into fuller details concerning this shipment.

In the correspondence of the Agent-General of last year two remarkable statements are made. Writing on October 30th, 1885, he says: "A shipment of trout ova, privately made by Sir James Maitland, had brought out most valuable information, showing how cheaply, as well as safely, ova could be got out under certain conditions, and, when the reports came Home of our shipments by the Ionic, Sir James wrote to me that he had no doubt whatever of perfect success next season, as we had now the key to the whole problem—namely, the period which ought to elapse between spawning and packing, and could ensure the success of every egg we sent;" and again, on the 18th November, "I believe that the most constant source of failure has been that ova were sent out which had never been impregnated at all; and you will perhaps remember Mr. Farr saying, in a letter recently published at Christchurch, that, having unpacked every shipment allotted to the Canterbury Society, he could without hesitation declare that not 10 per cent. of the ova had been fertilized."

In *The Transactions of the New Zealand Institute* for 1881, vol. xiv., page 209, will be found a valuable table showing salmon, trout, etc., distributed in rivers and lakes by acclimatization societies, extending over the period 1868 to 1880, both years inclusive. From that source we learn that British salmon—*i.e.*, young fish—were distributed from the following centres at the annexed dates. In 1878, by the Canterbury Society, 175; by the Otago Society, in 1869, 250; by the Southland Society and Mr. Howard, in 1874, 96; in 1876, 1,400; in 1879, 2,500; making a total of 4,421 young fish. In the official report of the Fisheries Exhibition, vol. xiii., page 168, will be found the following instructive calculation: "Sir J. Gibson Maitland says that 2,000,000 young fry may be bred at an expenditure of less than £1,000 a year. I suppose that it would not be an exaggerated estimate to assume that one-half of these fry turned into the river to take care of themselves would fall victims to trout, beetles, birds, and the many other enemies to which they are exposed in the first year of their existence. I suppose it would also be a moderate estimate to assume that one-half of the remainder would similarly perish in the second year of their existence. On the assumption then, that all the surviving fry became smolts at two years, I imagine that I cannot be over-stating the case when I say that out of the 2,000,000 fry there would not be more than 500,000 smolts. If the Tweed Commissioners' figures are right—that one salmon returns for 50 smolts—the 500,000 smolts might produce 10,000 salmon." Taking these proportions to estimate the returns of the salmon fry liberated in New Zealand by the acclimatization societies, it will be noticed that the number we had to expect to return from the 4,420 liberated fry would be only some 22. After the deposit of the ova by the female fish and its fecundation

by the male—two distinct processes requiring the presence of both fish—a period variously described from 50 to 130 and from 70 to 150 days elapses, according to the temperature of the water, until the hatching of the young fry takes place. For some six weeks the parr, as it is called, is a helpless infant, eating nothing, but subsisting on the oily contents of the umbilical sac or vesicle attached to the abdomen. Mr. Fryer says: "When about a couple of years old the young "samlet" prepares for his first visit to the sea, and dons a new tourist suit for the purpose." Mr. Home gives a different account of the early life of the young fish, saying: "Hatched in December or January, these parr go slowly down the river towards their ultimate destination, the sea; but they do not venture into the sea till another skin of glistening scales has been formed over their first skin; they then receive the name of smolts. If put into salt water before getting this silver dress they die. It is only a portion of the parr which go to sea during the first year. The rest, being probably more weakly in constitution, remain in fresh water till the following spring, when, if not devoured by natural enemies, they also put on a silvery dress and betake themselves to the ocean."

There is a difference of opinion among naturalists as to the early life of the salmon, but smolts appear to be regarded as two-year-old fish. "The time that intervenes," Sir James Maitland says, "between the smolt just entering the tidal water and its first return towards the river, varies considerably on the east coast of Scotland; two summers may sometimes intervene; and we must be careful not to assume that all fish return or attempt to return in the grilse stage." Mr. Home puts the matter in another way, writing: "The smolts after remaining in the sea for some months return to their native river, having grown to about 12in. in length, and weighing about ½-lb. They then go by the name of 'black tails.' They hover about the lower part of the river, not going far beyond the influence of the tide. Before winter they return to the sea, and in the following year they come back to the river as grilse, in June and July. For what purpose they come then is not known; when they come in September and October it is in most cases to deposit ova and milt in the spawning beds. After they have spawned they return to the sea, and if they come back next year, my opinion is that it is in the form of a salmon—a change corresponding to that of the heifer into a cow after her first calf."

But all salmon are not prolific. Even if the conditions for fecundating ova are in many cases fulfilled, many grilse and salmon remain sterile. "In the months of December and January, the usual months for spawning," Mr. Home says, "quantities of adult salmon are seen by cod, haddock, and herring fishermen,

12 and 15 miles from the coast, near the surface of the water, plying about, as the fishermen term it, probably being then in pursuit of food. Even in the river during the above months adult salmon have been seen, not seeking the spawning beds, but lying in deep pools."

These details are put into connected form to prevent any undue feeling of disappointment arising as to our hitherto unsuccessful attempts at salmon acclimatization. The chances of any of the fry turned adrift by the Canterbury and Otago Societies surviving the struggle for existence are very few. In the Canterbury fry liberated, 175 in number, there was no probability of a single survivor reaching the salmon stage, according to the estimate of the ratio of chances in favour of the young fry maturing, as propounded by Sir James Maitland; in the Otago distribution of 250, there was a probability of only one; in the 1,400 distributed in Southland in 1876, there was a probability of seven of the fry reaching the adult age; and in the 2,500 liberated in 1879, only that of twelve. According to the official report of the International Fisheries Exhibition, the chances against healthy liberated fry becoming salmon are at least 200 to 1—that is, if 200 fry are put into a stream where salmon are already inhabitants, the maximum of the chances are that 1 of the 200 will alone reach maturity.

The President and Honorary Secretary of the Waitaki County Acclimatization Society, writing to the Hon. Commissioner of Trade and Customs of New Zealand, in February last, put the statistics of salmon ova in a somewhat different light, saying: "On reference to previous shipments of salmon ova to New Zealand, we find that from 1868 to 1878, out of 824,000, only 3,996 survived to be turned out, and they have not been seen since; whereas, in Mr. Farr's shipment (alluded to above) of 120,000, nearly the whole arrived safely, and considerably more than half are either distributed, or ready for distribution."

Reference may here be expected to the land-locked salmon, as it is called, and about which so much has been written; but, of all the statements we have come across, that of Mr. Wilmot, the Canadian Commissioner at the Fisheries Exhibition, is the most worthy of attention. In a discussion which ensued on this variety of the salmon family he said: "His impression was that there was no such thing in existence as land-locked salmon, scientifically or naturally. It was the true *Salmo salar*, which had a different shape from the water it lived in. Land-locked salmon, which he called *Salmo salar*, was a fish which could be obtained by any pisciculturist at his pleasure; all he had to do was to hatch from the eggs of the *Salmo salar* a number of little fish, put them into a large body of water, from whence they could not reach the

sea, and, if they found food congenial to their wants, they would grow and develop into a large fish slightly changed in colour, and scarcely perceptible in form. Such had been his experience in America and Canada. Lake Ontario was once filled with this fish. When he was a youth he had known thousands killed in one night, and the farmers caught them in such numbers, as they entered the streams to deposit their ova, that some of them got enough to buy their farms with. In the stream which ran within a few yards from where he was born and brought up he had killed hundreds and thousands of them on their migration up from their sea—Lake Ontario—into the smaller streams and rivers to deposit their ova, in the same way as *Salmo salar* left the ocean and ascended rivers. For want of proper precautions, proper protection, and good legislation, this salmon had almost disappeared from Lake Ontario. At first there were no laws in the country, and consequently every man killed as he pleased, and, as the poor creatures came up, they were destroyed right and left. The Indians killed them, and the "white Indians" killed them still more. To prove that the *Salmo sebago* was the true *Salmo salar*, he might say that he had taken eggs of the *Salmo salar*, impregnated them, hatched them, and taken them up into the rivers running into Lake Huron, and to-day some of the true *Salmo salar* were found in Lake Huron, though smaller than were found along the coast. That was evidence to show that you might make land-locked salmon in any water you chose where the fish could find congenial food, and where they could not get to the sea. It might be said, How could the salmon in Lake Ontario be said to be land-locked when the St. Lawrence emptied that lake into the sea? Salmon were feeders in the sea, and breeders in fresh-water. They migrated annually to the rivers to reproduce. When they were abundant in the waters of the gulf, they passed up the St. Lawrence, entering every stream on either side up into Lake Ontario; and were it not for the great barrier of Niagara Falls, the salmon would be found in the upper springs of Lake Superior. It was their instinct to go onward and onward until they found a suitable spot for spawning, and they would have passed into Lake Erie and Lake Superior, the same as Lake Ontario, were it not for the Falls. The consequence was they entered into the smaller streams which fed the lake, and went back into Lake Ontario, instead of into the sea, where they had remained up to the present time, as the true sea salmon, only acclimatized to fresh water. Any gentleman in England who was desirous of having land-locked salmon, if he had a lake with a great depth in the middle and small streams running into it, into which the fish could go to breed, might produce land-locked salmon from the eggs of the salmon of the sea."

Mr. F. Day, writing to *Nature* of September 18th, 1884, gives the following definite statement: "On August 28th of that year

a grilse was taken from the salmon pond at Howietown, which measured 14in. in length. There are a large number there, but they are in too deep water to count. These fish were raised from the ova and milt of pure salmon taken in December, 1880. The specimen was a female, with the ova well advanced, being 0·1 in diameter, and would have bred this season. The fish was well nourished, with eleven rows or scales between the adipose dorsal and the lateral line, and sixty cœcal appendages. This solves the question that our salmon may not only be reared in a healthy state in suitable ponds of fresh water, but also, if properly cared for, will breed without descending to the sea. Last year the milt of the parrs from this pond were successfully used for breeding purposes." On another occasion he writes: "Land-locked salmon is admitted to be a race of the true *Salmo salar* which, from some cause having lost its migratory instinct, now lives in lakes, never migrating seawards, while its size is less than that of its sea-going relative."

Last year a large number were turned into the Thames River (England), and, being non-migratory, it is hoped will not leave the polluted waters it finds itself domiciled in. Whether it may survive in its new surroundings is quite another question. Some time since the American Government sent 30,000 fry to the English National Fish Culture Association, and the fish turned into the Thames will probably be a portion of the consignment.

The Pennsylvanian Commissioners lament that their State does not abound in deep, quiet lakes of large areas, in which the land-locked salmon finds the demands of its nature fully met. It may be stated that in England experiments are being made in cross breeding the land-locked salmon with the brook-trout.

On a kindred matter Chambers says, in the *Fisheries Literature*: "Much has been written for and against the rearing of hybrids; and whether the cross between the salmon and the trout will reproduce is still a disputed problem. Be that as it may, this fact remains unchallenged, that the progeny of the salmon *salar* and salmon *ferox* are well worth the attention of the fish culturist. The marvellous rapidity of growth they are known to make in a short period of time, and the ease with which they can be acclimatized, must commend them to us as fish of great economic value.

"In hybridising salmon with lake-trout all inclination to migrate ceases. A class of fish may therefore be produced useful in ornamental waters, lakes, or rivers, having no direct communication with the ocean. In making experiments of this nature we have the advantage of producing a class of fish that are very rapid growers and flesh producers. In this respect they bear an affinity with hybridised animals; and the stock can always be replenished by the assistance of fish-culture."

SEA TROUT (*Salmo trutta*).

It is thus described in appearance by Dr Günther.

"Attaining to a length of about 3ft.; females mature at a length of from 10in. to 12in.

"Young, with nine or ten dusky cross-bars; half-grown ones (grilse state), with the top of the dorsal and pectoral, and with the hind margin of the caudal, black; silvery, sometimes immaculate, generally with more or less numerous x-like spots; spots on the head and dorsal fin round, and readily disappearing."

"The marine and estuary-frequenting salmon-trout, salmon-peal, or sea-trout," writes Mr. Saville-Kent, "includes two well-marked varieties—the so-called white salmon; 'whitling,' or hirling, the *S. albus* of many writers; and the Welsh and Cornish forms, locally known as the 'Sewin blue-pole,' or bull-trout. . . . This species passes by imperceptible gradations into the purely fluviatale river-trout (*Salmo fario*), with its varieties too numerous to mention, and likewise into the famous migratory Loch Leven trout."

The sea-trout does not attain so large a size as the salmon, though it has been known to reach 24lb. The flesh is pink, richly flavoured, and much esteemed, though said to be inferior to *S. salar*. Chambers says its habits are generally similar to those of the salmon. Large shoals sometimes congregate near the mouth of a river which they are about to enter, and afford excellent sport to the angler in a bay or estuary, rising readily to the fly. The young are not easily distinguished from parr. It has many local names on its first return from the sea to fresh-water, when it has its most silvery appearance, in which state it has sometimes been described as a distinct species.

"From Tasmania, in July, 1870, 140 fry were brought. Eighty young fish were put into the Shag River in 1871, and some were put into the Water of Leith about the same time. The trout have thriven well in Otago Harbour and along the coast to the north, as fish ranging from 1lb. up to 20lb. have been taken by fishermen. It is curious," Mr. Arthur adds (from whom these details are taken), "that no undoubted sea-trout has as yet been caught or found spawning in any of our rivers." In 1874, Captain Hutton exhibited, at a meeting of the Otago Institute, a sea-trout caught in Otago Harbour, and stated that another capture had been recently made; while Mr. Thomson, in November, two years later, wrote: "Several salmon or trout were caught in the harbour."

The salmon trustees (Southland) report that the fry bred in 1870 spawned in 1875. The year following they distributed 1,100, of which 850 were put into the Oreti River. That trout of some kind or other have done well in the Oreti is evident, as in

the last report of the Southland Acclimatization Society it states that one angler, the last season, took 1,000lb. out of its waters. Mr. Arthur noticed a specimen netted by a Chinaman in Sawyer Bay, Otago, in April, 1880, weighing 2lb. 14oz., and measuring 17½in. long. Dr. Hector had a sea-trout sent him, caught in Nelson Harbour, in September, 1881, near to the mouth of the Matai. It proved to be a female that had just spawned. For the length of 25in. its weight (4lb.) was small, but it was lanky and out of condition, or it would have been a 6lb. fish. Dr. Hector considered the catch of great importance, from the fact that the only salmon-trout ever introduced to New Zealand were bred from a small lot of ova that came from Tasmania in 1870, and of which the original stock, turned out in Shag River, Otago, did not exceed seventy or eighty fish. What are supposed to be the progeny of these now abound on the Otago coast, and this discovery might seem to point to its having spread in its migration round the coast as far as Blind Bay. On the other hand, it might be suggested that what we know as brown trout in the rivers are of the large, fast-growing variety, known as the Thames trout, but which in New Zealand enter the sea and acquire the character of the true sea-trout.

The Otago Acclimatization Society's report for 1883 complains that the salmon trout continues to be poached in Otago Harbour, but none have been taken in any river. Recently, observers at Home have found that some salmon have spawned in the tidal way of certain rivers, but when exposed long to the action of salt water the ova have died. It is possible, therefore, that our sea-trout may have got rid of their ova similarly, although that would not account for young sea-trout being caught as well as very large and presumably much older ones. Although it has not been absolutely demonstrated, yet there is little reason to doubt that our brown trout (*Salmo fario*) above a certain size do frequent Otago Harbour more or less; and this, owing to the very silvery appearance thereby induced, adds to the difficulty of tracing the true sea-trout.

Sea-trout (*Salmo trutta*) have been for three years retained in captivity at the South Kensington Aquarium. Their ova has incubated, and their fry, at a late date, were reported as being in a healthy condition. The ova produced from fish in captivity, it is said, occupy a larger time in hatching out than those spawned from wild fish.

TAHOE TROUT.

Two shipments of the ova of this kind of trout, said to be one of the best of the numerous kinds of lake-trout found in Western North America, were sent to Auckland by Mr. T. Russell, C.M.G.

The report of the society (Auckland) says 30,000 were forwarded, but a large proportion were dead on arrival. About 3,000 young fish were hatched, but they proved to be difficult to rear, dying in large numbers before the absorption of the sac, and about 1,000 were all that reached an age suitable for liberation. A part were forwarded to Lake Omapere, and the remainder were turned out in Lake Waikare, save a few placed in the Onehunga Springs.

TENCH (*Tinca vulgaris*).

The tench has been acclimatized in the Middle Island of New Zealand, though it does not appear as yet to have been widely distributed. It is a powerful and handsome fish, which would well repay cultivation. It prefers lakes and ponds, and sleeps away the larger portion of the winter season in cold climates. It is very tenacious of life, and 250,000 ova have been taken from one fish. It spawns on water-plants, and the young fish hatch out in a week or ten days. A golden variety has been introduced into England, but is inferior as a food-fish to the common tench. Its food consists of larvæ, water-plants, and worms. Like carp, it eats well, and loses any muddy flavour it may have if kept for a time in clear running water. Instances have occurred of its attaining a length of 3ft., but a tench of half that length is unusually large.

The tench spawn when the wheat is in blossom, and the growth of the young are rapid. In stocking waters with tench we are told that two males to one female is the right proportion of the sexes, and certainly not less than three to two, at the outside, should be turned down for breeding purposes. The male tench is easily distinguishable by the larger size of the ventral fin, which, as Mr. Couch remarks, has a stout, thick, crooked, and transversely-striated fish-ray. A mixture of greaves and meal is excellent food for fish which are being kept for the table. On it they thrive, and a well-fed tench is a most worthy fish.

TROUT (*Salmo fario*).

In 1867 an attempt was made, Mr Arthur tells us, to introduce trout in Canterbury, but the experiment was a failure. In 1868, however, both Otago and Canterbury distributed young fish in their streams, and Auckland and Southland, two years later, did the same thing. Since that date trout has been sent all over the Colony; and now that evidence is conclusive as to their thriving in the Province of Auckland, their general acclimatization may be accepted as a fact. Our success is spoken of in England

among experts as "one of the most brilliant experiments in the annals of fish-culture." The first successful hatching of trout in Otago was in October, 1868, under the superintendence of Mr. Clifford, who got from the Salmon Commissioners, Tasmania, 800 ova, of which 720 were hatched at the Opoho breeding-ponds. A consignment of trout ova from Tasmania, through the Otago Society, to Canterbury, in 1868, produced 433 young trout, which were distributed in the Avon, Heathcote, and other rivers, and Lake Coleridge. In the same manner the Southland waters got supplied, and in 1870 the first brown trout ova came to Auckland from Tasmania, whereof sixty young fish hatched out and were put into Edgecumbe Creek, Western Springs. In 1876, Hawke Bay, Marlborough, Wanganui, and other districts entered the field of trout-culture, and the success attending their distribution has been so great that in many localities not only is angling licensed, but disputes and jealousies have arisen among local bodies as to the appropriation of revenues arising from trout-fishing. What will appear to many convincing proof of thorough trout acclimatization in New Zealand is the fact that while trout in England and Scotland spawn in October and November, we find that in Otago they do so later; that is, from the latter end of June to the end of July, and sometimes on to the middle of August, which months correspond to December, January, and February in Britain.

A few examples may be given of what kind of sport the anglers enjoy, and what size our trout attain.

In 1882, Dr. DeLautour, of Oamaru, had the following luck in the Kakanui River: December 3rd, two trout, weights 12½lb. and 3lb.; and on the next night five trout, weights 13lb., 8lb., 7½lb., 3lb., and 3lb.; being seven trout altogether weighing 50lb., or an average of fully 7lb. each. A female fish, 14lb. weight, was taken in the Waikouaiti River. In Fulton Creek, on the Taieri, in July, 1881, Mr. Deans caught two fish, 18lb. each. Mr. McKinmore, in March, 1883, killed, with native minnow, in the Puera, a trout of 22lb. In November, 1880, a trout was caught at the head of Lake Wakatipu, which weighed 16lb. 4oz., concerning which, Mr. Arthur says: "As it may probably have been one of those liberated in 1874, its yearly growth would be nearly 2¾lb." Of Hayes Lake the same writer adds: "Hayes Lake is very full of trout, some being supposed to be over 20lb. in weight, and these, having for their spawning ground only the mile and a-half from the lake to the waterfall of this creek, get very crowded during the spawning season. I have heard of one trout poached out of this stream in 1882 which weighed 28lb., and these great fish are known to have been actually caught, and removed in cartloads, being afterwards salted and sold among the surrounding goldfields." Trout weighing over 20lb. in weight have been caught in the Canterbury waters at least on more than one occasion.

The following table of the yearly growth of trout from 1878 to 1883 is taken from *The Transactions of the New Zealand Institute*, vol. xvi., p. 490:—

Rivers.	Lbs.
Oamarama	2·00
Kakanui	1·00
Waikouaiti	1·07
Fulton Creek	1·05
Lovell Creek	1·66
Puerua	2·20
Waiwera	1·45
Waipahi	1·00
Otaria	0·75
Mimihau	1·00
Pomahaka	1·08
Waitahuna	1·12
Manherikia	1·00
Hayes Lake	3·50
Wakatipu Lake	2·73

The trout in Lake Wakatipu are found frequenting the bay at the mouth of the creek at Queenstown in shoals, and, being quiet, fat, and lazy, have attracted much observation, and have been the subject of careful attention. In the shoals there is much fungoid disease visible, and a considerable number succumb to it. Mr. Arthur, who saw three schools, containing more than 100 fish each, perceived that at least 25 per cent. of them had marks of fungus on their bodies. On the larger trout a patch or two of dirty white was seen on the head generally, and a tuft hanging out of the side of the mouth; while in breathing they could not close their jaws, and showed very little motion in them at all. Some of the smaller ones were worse, their bodies and fins being covered with spots or patches. Observing a trout with its tail-fin out of the water, belly up, and head on the bottom, in shallow water, drifting ashore, he waded in, seized it by the tail and easily ran it out and laid it on the shingle. As it was nearly dead he did not kill it, and in a few minutes it succumbed. It weighed 7½lb. The fish was a female trout, fat, but dark in colour; badly spotted on dorsal and all the other fins with fungus; the gills were full of it, and a tuft hung out of the right side of the mouth, while the back and sides had a number of distinct marks or patches, some appearing as if due to the mucus covering having been eaten away by the disease. The margin of the right opercula and the origin of the right pectoral fin were also eaten away. Lying on the beach, near the creek mouth, he saw the skeletons of two other trout which had evidently come ashore after death.

Twelve hours after the trout drifted on shore an examination was made as to its condition. The writer thus continues: "Immediately after death it swelled and continued to do so till the abdomen became very much distended—a thing which never occurs with healthy trout. On opening it we found it full of ova, nearly ripe, the roe-lobes having a hard appearance; pyloric cæca fatty, but not healthy; stomach quite empty, and air-bladder very much swollen with gas. The other viscera seemed healthy. The teeth or body of vomer were gone, and the gills were of a dull purplish hue. In attempting to remove a patch of fungus from the gills it could not be separated, so firmly had the roots taken hold, and the tissues came away easily with it. The gills, in fact, were rotting. · · · From the appearance of this trout, and that of others in the shoal from which it was taken, it is manifest that these fish are in a chronic state of disease, and that not confined to the spawning season, for I have ascertained the presence of the fungus at other times, as in the month of March. Fungus has been found on trout at the Wallacetown Ponds in 1876, and recently a Marlborough gentleman told me of his taking out of some still pools in a stream in that district fungussed trout years ago; while our native fish are not always free from it." Those who feel an interest in this matter will find it fully discussed in *The Transactions of the New Zealand Institute*, vol. xv., pp. 198-203.

Respecting the fungoid on the trout in Lake Wakatipu, Mr. Arthur thus speculates on the cause of the disease: "In the first place, so many difficulties surround the investigation that the cause or causes of the disease cannot well be presumed to be stated exhaustively. At the same time, so far as our knowledge of the habits of trout and of the conditions necessary to their healthy life enable us to judge, we are warranted at least in advancing an opinion. I assume, then, that the trout in Queenstown Bay were spawned in Town Creek—a stream far too small for the subsequent accommodation of the size to which these attain. The water is very deep throughout this bay, but has a shallow margin a few yards in width running round parallel to the beach. The great body of the lake itself is abyssmal, the only sounding got as yet being at a depth of 1,300ft. The fish growing too large for their parent stream, they have naturally dropped down to the lake during floods, and while there have so increased in size in the course of a few years as to become physically incapable of again ascending the stream at their regular spawning season. No stream large enough seems to be sufficiently near, and the great depth of water along the shore to the west, without leading shoals, tends to confine the trout, so to speak, to one place, or at least to operate against their migration in that direction. In this respect the Wakatipu is totally different from the streams where the progenitors of our trout live in

England, where the water does not probably have a greater average depth than 4ft. With the true instincts of the *salmonidæ*, however, the trout in Queenstown Bay linger near their parent stream, unable, so to speak, to convince themselves how it is they cannot be again admitted, and, diseased as they have become, present an appearance suggestive of the lame and sick folk of old, who waited for the troubling of the water. Being unable, then, to fulfil the functions of nature at the spawning season is the first contributing cause to the outbreak of the fungus.

"Again, the chemical constituents of the water have an important bearing on the health of the trout. Trout under domestication, when attacked by fungus, have in almost all cases been cured by the addition of common salt to the water supplying the ponds or tanks containing the fish, provided the disease has not been permitted to go too far. Dr. Black reports that the Wakatipu water has less salt in solution than any water ever examined by him. Now, as salt is an essential to health in trout, its entire absence in the water under consideration must act prejudicially on these fish. This is the second and only known cause tending to accelerate the outbreak of the disease. But there is yet another cause which I suspect, although not in a position to prove—namely, the absence of a due proportion of oxygen among the gases held in solution by the water. To determine this, not only is a gaseous analysis required, but it is also necessary to find out what that quantity of oxygen is which trout require. Science has yet to discover this ratio, so far as I know, and it is an important element in its bearings on this question. As already stated, the fact of the trout seeking those places, as the mouth of the creek and the reef, where oxygen is likely to be most abundant owing to the constant agitation of the water, shows that the instincts of these trout teach them to look for water where the best æration is to be found.

"These causes, then, seem to me sufficient proof that the disease among the Wakatipu trout has been consequent on functional derangement, and that this has so lowered the vital force of the fish as to leave them powerless to resist the attacks of the fungus, a plant which the best authorities tell us is present in all fresh waters."

Writing the year following, Mr. Arthur said: "I may be pardoned if I again give my opinion that all the exciting causes of the affection may be narrowed down to two conditions—namely, the absence of sufficient salt in the water inhabited by the fish, and of sufficient oxygen in the blood of the fish itself."

Mr. Farr writes, in *History of Trout Culture in Canterbury*: "While considering the cause of the fungoid which had attacked [illegible], it occurred to us, that, as the bottom of the ponds in

which they were kept was muddy and quite free from any kind of gravel, it might be that the fish could not scour themselves as they were wont to do, therefore were unable to remove the scaly adherence. This thought grew in force with us, and, after the season, gravel was put on the bottom of the ponds. . . . And the next season the fish cleaned themselves with the gravel and the disease disappeared."

The shoals of large trout in the Queenstown Bay have no chance to scour themselves in this manner, unless they cross the lake or ascend some of the tributaries at its head or sides; but, Mr. Arthur says, the trout in the bay are not migratory, but hang about the creek mouth and peninsula reef. That the trout are distributed all over the lake seems certain, as in November, 1880, a trout was caught at the head of the lake weighing 16lb. 4oz.

There is one other point to which we are much indebted to Mr. Arthur's attentive observation. He writes: "Migration appears to be the refuge of trout in Otago when planted in a stream deficient in size, range of water, and of food, hence the disappearance of the largest trout from the Water of Leith, except during the spawning season. They evidently resort to the salt-water of Otago Harbour in search of more water and more food than can be got in the Leith, for trout of the common *Salmo fario* species are being constantly caught in fishermen's nets in the bay. They show a tendency to acquire a sea-trout appearance, as they are usually very silvery, and the black spots are often, but not always, cross-shaped. The belly fins also become very white, and the head gets sharp and fine." He gives many other illustrations of the migration of trout towards heavier water than found in ordinary trout streams.

The acclimatization societies do not, however, consider that the trout are as yet sufficiently well established in the Colony to preserve an existence without artificial aid, for, in the report of their conference in Dunedin, in April, 1883, we find them saying: "Our experience is that in many streams the stock of trout has not succeeded well of late years. We find where they were numerous and large a few years ago, they have diminished in numbers to an alarming extent, even when supplemented in their natural spawning by thousands of fry artificially reared. This shows us that we cannot depend on the stock of trout in a river keeping itself up by natural spawning; it must be kept up by other means—namely, by artificial hatching, and distribution annually. Besides which, we are not in a position to say how trout will ultimately succeed in our streams when the relations between the supply of food and the number of fish have adjusted themselves; and it would be presumptuous, in the present state of our experience, to pretend to say that trout are established so firmly that

they will not disappear if left to themselves. The reasons for this loss of fish in the rivers are fishing, poaching, and the natural food-supply being diminished; also the ravages of their natural enemies—shags, gulls, eels, etc. Fish-culturists in America and in Europe are very decided in recording the disastrous results, as their countries, of over-fishing and want of artificial stocking. By these, and other means combined, salmon and trout have disappeared from many New England rivers, and from some European rivers also. Such a fee for trout-fishing as the 5s. colonial licence, fixed by the House of Representatives in 1882, would result in rapid disaster to the stock of trout. No society could afford to keep up its fish supply on licences fixed at such a nominal rate; therefore they would simply cease to stock rivers gratuitously, and the result in a few years would be no trout in the rivers. Every one could fish, and there would be no efficient protection."

Beside the dangers pointed out by the conference, another has been found in the droughts prevailing in the Canterbury Provincial District, as a local paper lately stated that the water in the north branch of the Ashburton River had entirely disappeared, and that a large quantity of fish had perished in consequence. Over fifty trout were found dead in the river-bed, near Mr. J. Corbitt's residence, about 4 miles from the town. Some of the fish weighed from 5lb. to 8lb. A quantity of small trout were also noticed in a very sickly state, in small shallow pools. At Kawau, when the water in the creeks reached a temperature of 70°, Sir G. Grey found his trout dying. Mr. Arthur writes: "Trout in Shag River (Otago) have died, as supposed, because of excessive heat."

Connected with the temperature of water and fish life, there was an interesting experiment made last year at South Kensington to test the highest temperature endurable by various species of fish. The following fish were selected for trial—namely, the carp, gudgeon, dace, roach, perch, minnow, golden-tench, common-tench, trout, and salmon, all of which were deposited in cold water registering 53°. The temperature was then gradually increased by the infusion of hot water through a tube, which caused the temperature to rise steadily. None of the fish, however, exhibited signs of fading vitality until the thermometer reached 82°, when a perch became prostrated; and shortly afterwards its congeners followed its example in rapid succession in the following order: Roach, 82½°; salmon, 83°; minnow, 85°; gudgeon, 85½°; dace, 86°; common-tench, 88°; golden-tench, 88°; carp, 91°. *Nature*, from the excellent columns of which this information, with much other appearing in these pages, is extracted, says: "Each fish on showing sign of exhaustion was

removed from the water, dosed with a small quantity of brandy, and replaced in the tanks from whence taken. All the fish experimented on, save the dace, were found the next day swimming about as usual."

INSTRUCTIONS FOR THE HATCHING OF TROUT OVA.

(Circulated by the Auckland Acclimatization Society.)

The first step is to make the necessary provision for the reception of the ova while hatching. For this is required—first, hatching-boxes; second, a supply of pure cold water, taken by means of a pipe or flume from a suitable stream, and then led into the boxes; third, a shelter or shade-house for the hatching-boxes.

The hatching-boxes are about 4ft. in length, 9in. wide, and 6in. deep, clear measure. They should be made of inch timber, well fastened together, so as to be as nearly as possible water-tight. Each box should have its bottom covered to a depth of 2in. with clean shingle. This must be obtained from the bed of some fresh-water stream, the stones being picked about the size of beans or rather larger, and well washed to clear away mud or other impurities. Two or three boxes will be required, as not more than 250 eggs should be placed in one of the size mentioned. They should be placed close together in the form of a flight of steps, the front box being 4in. or 5in. lower than the one behind it. A hole should be bored with a $\frac{3}{4}$in. auger near the top of each box and close to the end, and a small spout or pipe inserted, so that the stream of water can flow from the box and drop into the one below. A piece of perforated zinc or scrim is placed on the inside of this hole to prevent the young fish passing through. The boxes should be well soaked in water before being used, to get rid of any sap in the timber.

The supply of water required is comparatively small, and what would pass through a $\frac{3}{4}$in. pipe is amply sufficient. Some means must be provided for regulating the flow, so that a smaller or larger quantity may be admitted into the boxes, as the necessities of the case may require. Care should be taken that the water is continually running, and that it is as pure and clean as possible. It is best led into the boxes at the end, and should fall from a height of 3in. or 4in., so as to ensure proper æration.

The shade-house is for the purpose of sheltering the ova from the sun, and of excluding kingfishers, shags, fowls, etc., which would pick up the ova out of the boxes. Any shed that answers this purpose would be sufficient, whether constructed of boards palings, or raupo. A wattled shed of ti-tree would not do, as too much litter, leaves, etc., would drop into the boxes. The shed must not be too closely built, as good ventilation is indispensably required.

The ova will be sent packed in a small box contained in a larger one, and surrounded with ice. The box must be opened with care, and the ova will be found between sheets of netting packed with moss. They must not be touched with the fingers. but taken gently with a teaspoon, placed in a saucer or pannikin with a little water, and then gradually dropped over the surface of the shingle in the hatching-boxes, to which the flow of water has been previously admitted. The flow of water must then be regulated so as not to wash about the eggs, and kept at that point. The healthy eggs will be of a fine pink colour, with much of the appearance of red currants. When placed in water they will look a little paler. Any that turn an opaque yellowish or chalky-white are dead, and must be at once removed, taking great care not to disturb or touch the living ones. Every morning the boxes must be examined, and the flow of water attended to, and any dead eggs removed.

The eggs will probably commence to hatch within a week after being placed in the boxes, but may remain a longer period, even up to three weeks, according to their forwardness when received. The young fish are very sluggish and inactive for some time after hatching, and will endeavour to conceal themselves among the shingle, and among which they are very difficult to see. They require no food; a portion of the egg still remaining attached to their under surface, in the form of a sac or bag, and furnishing nutriment for them. They should not be handled or disturbed in any way, and the only attention that is required at this period is to carefully examine the boxes every morning and remove the dead ones. The best way of removing either eggs or fish when dead is to take a hollow glass tube or reed about 8in. or 9in. long and about as thick as the finger; press the thumb tight over the upper end so as to entirely close it, and then bring the lower end into contact with the egg or fish to be withdrawn. Then take away the thumb, and the inrush of water will carry with it into the tube the dead egg or fish. The thumb can then be replaced, and the tube with its contents lifted out of the water. About four or five weeks after hatching the young fish will have absorbed the remains of the egg, or nearly so, and will have become lively and active. They are now ready for liberation, unless it is intended to keep them a longer time and feed them.

The best way of liberating the young fish is as follows: They must be gently caught by means of a little hoop-net made by fastening some thin muslin or netting over a wire circle, and placed in a bucketful of water, and immediately carried to the stream in which it is intended to place them. If the distance is considerable, the water must be frequently changed, and folds of scrim or flannel put round the bucket and kept wet, to prevent the sun from heating the water. In liberating them, select a place where there is comparatively little movement of the water,

but with gravelly or stony rapids above and below, and where there are a few stones under which the fish can shelter for a time. Not more than twenty or thirty should be turned out in one spot, but similar places should be selected at short distances apart, and fish put into them until the whole number is liberated.

The fish cannot be retained in the boxes for a longer period than five weeks without being fed. This demands some little expenditure of time and trouble, and must be very carefully and regularly attended to if success is desired. Under ordinary circumstances, therefore, the society would recommend that the fish should be turned out before feeding is required; but the following instructions will be useful to those who wish to keep them in confinement longer. For feeding, nothing is better than the curd of sour milk, from which all the whey has been removed by well washing with water. Small quantities of this should be put into a pepper-box with water. Then shake over the hatching-box, when fragments of the curd will be forced through the perforated lid, and will be readily eaten by the young fish. On no account should more be put into the boxes than will be actually consumed at the time. The fish will require feeding twice a day. After a little time they should be removed into a small pond, through which a constant flow of water passes. They could then be fed on chopped meat or maggots until finally turned out. At the bottom of the pond a number of large stones should be so placed as to form shelter or hiding-places for the fish, and care should also be taken to exclude eels.

WHITE FISH (*Coregonus albus*).

"This species of white-fish, which has been sought to be introduced into New Zealand, is," Dr. Hector writes, "the most valuable of a large number of species of that genus, which are distributed throughout the fresh-water lakes and streams of the northern hemisphere between latitude 46° and the arctic circle. The representatives of the genus in Britain are the *vandace* of Loch Mabin and Lake Windermere, the *powan* of Loch Lomond, the *pollan* of the Irish lakes, and the *gwyniad* of certain lakes in Wales.

"In America there are several species, some of which ascend rivers from the sea, while others, of which *Coregonus albus* is one, are chiefly confined to lakes. The American Commissioners express the opinion that few fish will better repay efforts for their multiplication than this white-fish, and large sums are being spent in the propagation and introduction of this species to the various northern and winter stations, where they are not found naturally.

"The excellence of the white-fish as an article of food is described by all travellers in the northern regions of America, where it forms the staple diet of the Indians and trappers during a large part of the year. It is a plump-bodied fish, free from small bones, with firm delicately-flavoured flesh in large white flakes. It is highly nutritious, but at the same time free from the rich oil which renders the salmon so cloying to the appetite when constantly used as food.

"The size of the full-grown fish is pretty uniform if caught in the same locality; but in some places they reach a weight of 20lb. and even 40lb., while in others the average is about 2lb. weight, the difference being, no doubt, due to the paucity or abundance of their favourite food, which consists of small crustaceans and shell-fish. They grow rapidly, the weight increasing about ¾lb. for each year's growth, the fish of the first season, or about eighteen months old, generally weighing 1¼lb. They are very fertile, the number of eggs deposited by the female being about 10,000 for every pound-weight of fish. They have the great advantage of being in season and procurable at all times of the year, although they have regular migrations from the shallow to the deeper waters of the lakes, and to the shoals at the outlets of the lakes for the purpose of spawning. This takes place in the month of November, or just before the winter sets in. At this time the temperature of the surface water is about 43° in the larger lakes. When, owing to the shallowness of the water in which the ova are deposited, the temperature falls to 34° or 35° during winter, they do not hatch out until April, but the usual period is 100 days between the spawning of the ova and the emergence of the young fish.

"The chief difficulty in propagating the white-fish arises from the circumstance that the ova are coated with an adhesive mucus, that renders their manipulation more difficult than in the case of the salmon ova. The young fish are also more difficult to rear, and it has never been successfully done yet except by turning them adrift in suitable water at a very early age to shift for themselves, as their food consists of minute infusoria, or similar diet, that cannot be artificially imitated. The minced meat on which the young salmon thrive so well will not answer for the white-fish, according to the evidence quoted by the American Commissioners."

And here, while I think of doing so, it is only right to state that no person can read through the correspondence respecting the acclimatization of fish in New Zealand — especially that portion relating to the introduction of the ova of the Californian salmon, and the white-fish—without feeling a strong admiration of the persistent efforts of Mr. J. C. Firth, of Auckland, to ensure

success in the enterprise; nor fail to mentally compare his generous expenditure of time and money with the lagging and verbose efforts of others, from whom patriotic efforts rivalling those of Mr. Firth may have been appropriately, if not as confidently, expected.

There have been several attempts to propagate white-fish in New Zealand, but they have all ended in apparent failure, whether undertaken by the Government or by the acclimatization societies. The first shipment arrived in Auckland in January, 1877, and Dr. Hector, writing to the Hon. Spencer Baird, on February 9th, says: "The ova were transferred from the ice-house of the large steamer in Auckland Harbour, on the 29th January, and did not reach the breeding ponds at Christchurch for five days afterwards. . . . The Secretary reports that over 200 young fish have come out. . . . I fear the experiment in this case will only prove a partial success." On February 28th, Dr. Hector reports to the Colonial Secretary the arrival of the second shipment—250,000 in all—which was forwarded to the Makarewa (Southland) Ponds for hatching. Of the shipment sent to Canterbury, Mr. Farr wrote: "It is with the deepest regret I have to inform you that we believe every one of the fish have been lost." It appears they escaped through the holes of the perforated zinc at the end of the hatching boxes. There was less doubt about the fate of the ova sent to Southland. Mr. Howard, writing to Dr. Hector, gives the following interesting, though disappointing, details: "The ova were detained in Dunedin until Tuesday night, when they left by the Wanganui, not reaching the Bluff till sundown on the following day, and were opened at the ponds on Thursday morning. I regret to say there was little or no sign of ova having ever been there, except here and there a smear of glutinous-looking substance, with a vile smell. No one unacquainted with its original contents could have ever supposed ova were there at all." In February, 1878, another consignment arrived at Auckland, which was, in the main, forwarded South by the Hawea. There were ten boxes, supposed to contain 50,000 ova each. One box was taken charge of by Mr. J. C. Firth, who says: "White-fish ova turned out very badly—all destroyed but thirty. Some of these died in hatching; others died soon after. Two fish living; eight ova yet to hatch." The ova sent South in the Hawea was distributed as follows: 100,000 to Canterbury, 100,000 to Otago, and 200,000 were taken to stock Lake Te Anau. Let us follow the Canterbury lot first. Sir J. Cracroft Wilson, who took much interest in the experiment, wrote: "That the majority of the ova had hatched on the voyage, . . . the fry from which were dead. Finally, about twenty eggs produced fry in the hatching-boxes of the society. Two of these died previous to Sunday, the 17th March. On that day, in consequence

of a hot wind, · · · six more died; and as it was feared the remainder would not survive the hot weather," when the narrator, by the aid of railway, horses and traps, freezing mixtures, and ice, transported them to Lake Coleridge, and liberated them in a small rivulet. The 100,000 sent to Otago was for a season more prosperous, as 1,000 fry were hatched and doing well at the breeding-ponds. Mr. Arthur describes their fate in the following manner: "The last I know of them is that Deans started with the whole lot for the Wanaka before they had reached that age and size which would be prudent before turning them out. He got as far as the Teviot, but they nearly all died or escaped during the night into a creek where the cans were put." · · · Dr. Hector, at the request of Colonel Whitmore, took charge of the ova intended to stock the Te Anau Lake, and reports his adventures at some length. Landing with his freight at the Bluff, a special train was waiting to convey him to the Elbow, where the two chests—one containing the spare ice, and the other the ova—weighing above 600lb., were transferred to an American waggon, with leather braces; and, having covered them with blankets and their tent, a start was made at 2.30 p.m. Travelling the greater portion of the night and the next day, until 3 p.m., the party reached their destination, and as the hatching-troughs had been previously prepared no time was lost in unpacking the ova, and by 6 p.m. the operation was completed, and the result of the experiment ascertained. The Doctor had better relate the sequel himself: "I regret to say this was not very satisfactory, as out of the four boxes of ova three were almost completely destroyed by the growth of white fungus, and the young fish, which had evidently been hatched out for some time, were reduced to a pulpy jelly. In the fourth box, in which there was only a slight growth of fungus, a considerable number of the ova were found in sound condition, and hatched out rapidly as they were transferred to the trough." The other box of ova appears to have been sent to Mr. A. M. Johnson, of Opawa, who described them as all hopelessly bad.

The next consignment of 2,000,000 ova came to Auckland early in 1880. The share allotted to the Auckland Society was 500,000. The society reports as follows: "About 50,000 were retained for hatching at the Domain fish-house; the remainder it was decided to forward to Lake Taupo, to Tarawera, and adjacent lakes. The greater part of the ova was placed in Lake Taupo, but good parcels were also deposited in the Awahou basin, and in Lakes Okataina, Tikitapu, and Tarawera. · · · The parcel retained for hatching in the Domain failed to produce any practical results." The year following we find the following: "The Council have received no information whatever respecting the white-fish liberated last year in Taupo and other lakes, and fear that the experiment has little chance of proving successful."

In Napier the report was not at all more hopeful or encouraging. The fish began to come out well after arrival, but did not live longer than twenty-four to thirty-six hours. At Nelson all died but eight or ten, and the survivors disappeared. At Christchurch (to again quote Mr. Arthur) very much better results attended the experiment in January, 1880, when 500,000 ova, less bad ones, were placed in the hatching-boxes at Christchurch. Hatching began on the 20th and ended on the 29th. The number hatched out was estimated at 50,000, but great numbers died from fungoid disease. These were removed daily until February 24th, when about 25,000 remained. These were conveyed by rail and buggy to Lake Coleridge in twelve hours and then liberated, only 200 being lost *en route.* Blood was used to feed the fish from the first. Describing their liberation, Mr Farr says: "Looking after them for a few seconds, we noticed they took a spiral course to the depth of about 8in.; then dived suddenly downwards, and were lost to sight in the deep azure water." Two boxes of the consignment were sent to Mr. A. M. Johnson, of Opawa, of which the recipient gives the following details: "The first box contained but very few good eggs, from which twenty-eight young fish have been obtained; the second box, which suggested the idea of perfection in packing, the eggs presenting a fine, healthy appearance in the layers of soft open scrim and moss. As soon as hatched, a proportion of the young fish were placed in various compartments, under different circumstances." Day by day, however, the fry disappeared, and the success was only partial at the best. Their fate is apparently unknown; but, like the Nelson fry, they disappeared. The second shipment sent to the Otago Society in 1880 was conveyed direct from the Bluff to the hatching-boxes in Lake Wakatipu. Mr Arthur says: "The ova were hatching when put into the water, which had a temperature of 48° to 52°, but none lived longer than thirty-six hours. Mr. Deans observed that some of the fish before they died appeared to have fungus, the tails getting quite white in appearance. So great was the mortality that Mr. Deans turned them all out into Lake Wakatipu, part at Beech Bay, and part at Half-way Bay, 21st January, 1880, but nothing more has been heard of them."

The February mail (1886) brought to the order of the New Zealand Government 1,000,000 white-fish ova; but they arrived in a putrid condition, and it seems probable that they were neglected on the voyage between San Francisco and Auckland.

Regarding our baulked efforts at acclimatization as final would, the compiler thinks, be a mistake, as the white-fish has been introduced into England and thriven. In *Nature*, of May 28th, 1855, appears the following paragraph: "The experiment of acclimatizing the American white-fish (*Coregonus albus*), lately

tried by the National Fish Culture Association, has met with great success. Until now the attempts made were unsatisfactory, the utmost difficulty being experienced in finding suitable lakes for the reception of this valuable edible fish. The white-fish in question were incubated at South Kensington in March, and afterwards transferred to ponds at Delaford, where they have thriven well." A later paragraph says: "The white-fish now in the ponds at the Delaford Fishery are growing rapidly, some of them reaching 7in. in length."

The Marquis of Lorne has successfully planted some white-fish in a specially constructed lake on the Isle of Mull. The fish were reared by the English National Fish Culture Association. Nor should local opinion in New Zealand be disregarded, as those resident in the vicinity of Lake Coleridge are inclined to believe that the fish liberated by Mr. Farr in the lake have not only lived but multiplied.

In connection with this matter the remarks of Mr. Creighton, in a letter to Mr. J. C. Firth, in 1878, are worth reprinting, remaining as they are almost buried in the Parliamentary papers. He said: "Since I wrote to you *re* white-fish, I have learned some facts which are of interest relative to the artificial hatching of them, from the State Fish Commissioner (Mr. Redding), and the foreman (Mr. Woodbury), which you should know.

"1st. Mr. Redding declares that it is almost essential that they should be hatched out at the first point of landing, owing to their delicacy. They will thrive anywhere if the water is deep enough, their food being small crustacea adhering to rocks in fresh-water lakes, having a current running through them. They should have a sandy and gravelly bottom.

"2nd. They are much more difficult to manage than salmon, and, until recently, little was known of their habits. They lose their sacs in ten days at a temperature of 35°, and earlier at a higher temperature. It will be necessary to feed them three days afterwards, or perhaps earlier, if they are to be transported any distance. The Fish Commissioners of Wisconsin discovered this year that white-fish could be fed with blood for an indefinite period, and in the San Leandro hatching establishment, and Lake Chabot in this State, the same experiment has been tried with success.

"3rd. Whitefish, as soon as hatched out, rise and swim, unlike trout and salmon, which lie dormant. The little fellows are, therefore, carried down the trough with the current, and, unless fine wire screens are placed across it to intercept them, they are almost certain to be lost. It was in this way, I suspect, the Christchurch society lost their white-fish, and not by a fresh during the night, as was reported. No. 18 (eighteen) mesh will

keep them in. They should have as much back-water as possible to swim in. In ten days, as I have said, they lose their sac at a temperature of 35°, but, as they may lose it earlier, it is necessary that a register of the daily temperature of the water be kept, and food be furnished as above described." He adds in a later part of his letter, "I forgot to say that white-fish take bait. They should be closely protected for *at least four years.*"

In March last some millions of herring ova were placed on board the Ruapehu with the hope of their being introduced into our waters, but the failure of the experiment was discovered when the steamer had reached Madeira. The introduction of the lobster and crab was also contemplated, but, as the lobster would have to be brought out in tanks, and the crab is somewhat difficult to feed when in captivity, their attempted introduction was probably deferred until the result of Mr. Saville Kent's experiments in Tasmania are known.

SEALS.

A VERY amusing and instructive chapter in New Zealand history could be written on the early sealing parties frequenting the southern and western coasts of the Middle Island, but the collection of details has been left too long to be either accessible from surviving sealers or easy of collation from scattered records.

Mr. S. Thomson, in his story of New Zealand, remarks of the sealers: "These men commenced their intercourse with the Natives in the southern parts of the Middle Island about the beginning of the century, being landed from whale-ships for the purpose of killing seals, then very numerous all round the coast. Disputes at first arose between the sealers and the Natives relative to property and women, and in such conflicts the sealers adopted the New Zealand custom of slaying the first Native they encountered; but both races soon became sensible of the benefits of peace, and the savages, to promote this great object, gave the strangers wives and Cod-Fish Island as a residence. Here they built houses and cultivated the soil, and when their numbers increased they spread themselves round the coasts. Between 1816 and 1826, 100 sealers were permanently settled in New Zealand, and in 1814 a vessel, of 150 tons burden, was built by them at Dusky Bay. Sealers in character resembled whalers, and Stewart, who first discovered the insularity of the Southern Island, was a good specimen of the sealer class. By birth he was a Scotch Jacobite, who had seen the world and drunk burgundy. After a residence of many years in New Zealand he returned to Scotland to see his forlorn wife; but she, conceiving him dead, had long before wedded another, and now denied his personal identity. Affected with this reception in the house of his fathers, he returned to New Zealand, took up his abode among the Natives, and in 1851 died at the age of eighty-five years, in a destitute state, in Poverty Bay. To the day of his death Stewart wore the tartan of his royal clan, and was occasionally seen sitting among the Natives, passing the pipe from mouth to mouth, and relating tales of his fishing adventures, which in length and variety resembled those of Sinbad the Sailor."

Of the influence for good exercised over the Natives by the sealers and whalers, the Rev. Mr. Wohlers gives interesting testimony in his article on the Conversion and Civilization of the Maoris

in the Southern Island, confirming the assurance given by the previously-quoted writer of the beneficial effects of pre-missionary European intercourse with uninstructed Maoridom. The records of the days when the sealers congregated in the Southern Island are scanty and scattered in our miscellaneous New Zealand literature; and as the seals had almost disappeared from our coasts before 1840, it is in vain to look for information from official sources. New South Wales could possibly aid in filling up the gap in the first forty years of this century; but the Customhouses of Boston and New Bedford would have to be ransacked to enable us to gather aught like complete knowledge of how prevalent seals were in New Zealand when its seal fisheries obtained a wide notoriety. This information would have been accessible had the late Mr. Sterndale been enabled to carry out the plan he contemplated of gathering such details, with many others, together, and bringing out a new edition of Findlay's *South Pacific Directory*. The details would be valuable, beyond gratifying what some would call an idle curiosity, in causing legislation to grasp the importance of an industry the past proportions of which are now largely underrated.

The Maori name for seal is kekeno.

There are three species of seals in New Zealand—the grey Australian fur-seal (*Arctocephalus cinereus*), the sea-leopard (*Stenorhynchus leptonyx*), and the sea-elephant (*Morunga elephantina*)—found only on Macquarie Island. The small fur-seal (*Gypsophoca subtropicalis*) is generally considered to be the young of *Artocephalus cinereus*. Mr. A. W. Scott, M.A., of New South Wales, has furnished a list of synonyms of the several varieties, ignoring other classifications as tending to confusion. For the sake of simplicity his classification is adopted, and his descriptive matter reprinted. It has the dual merit of being easily understood, and bearing, as it were, the *imprimatur* of the Government of New South Wales. His general description of the seal is as follows:—

"The front limbs of all the animals which compose this order are powerful, short, nearly hidden within the skin of the body. The paws, however, advance, are fin-like, and provided with five long fingers, which diverge from each other, and are completely embedded in the surrounding membrane. These fingers in general diminish in size from what we may call the thumb to the little finger.

"The fore limbs are used for swimming purposes, for seizing the prey, for assisting in movements on land, and for ascending rocks or blocks of ice.

"The hind limbs are even more powerful than the front ones, and when at rest are in some species directed forwards, similar in position to those of terrestrial mammals; in others, backwards, in a line with the body, which they terminate. The bones are

short and strong. The five toes of the foot are filled up between with a flexible membrane, which enables them to spread out when in action into broad, webbed paddles, and again in repose to fold together. Of these toes the lateral ones are the largest, the others diminishing towards the centre. By means of these hind limbs, seals are principally rendered expert swimmers, and perform their evolutions in the water with ease, rapidity, and endurance.

"The body is elongated, conical, and tapers from the chest to the tail. It is clothed either with long, soft, compact hair, enveloping a valuable under-fur, or with hair short, smooth, firmly adpressed to the skin, and slightly unctuous. The mammæ are ventral. The head is round, with a large, full, fleshy muzzle, studded with long stiff bristles. The eyes are large and dark, expressive of intelligence, and eminently adapted for seeing under water. The ears are very small, mostly not visible externally. The neck is long and flexible; the cervical vertebræ, free. The sternum is usually composed of eight bones, to which nine or ten pair of ribs are directly joined. The costo-sternal ribs are cartilaginous. The dorsal line is without any protuberance. The tail is very short, usually compressed, and placed immediately between the hind feet.

"As might be expected from this peculiar structure, so admirably adapted for the watery element in which they pass a great portion of their lives, these animals when on the land are very ungainly in their movements. It is only in a few species where progression appears to be accomplished, though very awkwardly, in a manner similar to the terrestrial quadruped; while in others it is obtained by bending or arching the extremely flexible backbone, by fixing firmly the posterior portion of the body on the ground, and then by suddenly straightening out, in front, the whole frame. By a quick repetition of this movement, a series of jerking leaps takes place, and, assisted materially by the fore-paws, a speed is attained, especially on the ice, sufficient to outstrip a man running in pursuit. Seals are eminently gregarious, and consequently are seldom met with except in large herds. They resort to the land for the purpose of bringing forth and suckling their young, which at a birth is commonly one, very rarely two; for basking in the sun, in the warmth of which they delight; for repose and slumber during the night, and for shelter from tempestuous weather.

"To ascend rocks or masses of ice of ordinary elevations they fasten their fore-paws, with the grip of a vice on inequalities, and, uplifting their unwieldy carcasses, they with tolerable facility gain the summit. But when the sides of these elevations prove too precipitous, they await the swell of the wave, which wholly or partially floats them to their purposed place of repose; but in the latter case they cling with tenacity to the face of the rock until another and larger wave lifts them to a sufficient height.

"The brain of the seal tribe is usually much developed, and writers best acquainted with the habits of the species accord to these animals the possession of a considerable amount of intelligence and sagacity, scarcely inferior to those exhibited by the dog. This favourable opinion has been frequently verified by many interesting examples, while in a state of semi-domestication, although it is palpable that these faculties, when exercised in their natural element, the full extent of which we can have no means of accurately ascertaining, must necessarily excel those which they manifest on shore."

The genus *Arctocephalus* Mr Scott divides into two main species—the northern fur-seal of commerce and the southern fur-seal of commerce (*Arctocephalus ursinus* and *Arctocephalus Falklandicus*), but states, in his account of the northern seal, it will be seen that, when he treats of the southern fur-seal, the description of the size, the colour of the hair, and under-fur of the northern animal is applicable to both; and that, in an account of the habits of the northern seal, those of the antarctic fur-seal will be found to be equally and truthfully depicted. It must be remembered that he considers and treats the *A. ursinus* as identical with *Otaria ursina*; and as the latter, the fur-seal of Alaska, is similar, if not identical, with the fur-seal of New Zealand (if Mr. Scott is correct in his assertion), the regulations for seal preservation, which have been so successful in the Pribilov Islands, are a safe guide for us to follow and to adopt in New Zealand.

THE SOUTHERN FUR SEAL (*Arctocephalus cinereus*).

SYNONYMS—*Arctocephalus Falklandicus.*
,, *antarcticus.*
,, *nigrescens.*
Falkland Island seal.
Phoca Falklandica.
,, *antarctica.*
Otaria Falklandica.
,, *Delalandii.*
,, *cinerea.*
Arctophoca Philippi.

Mr. A. W. Scott, M.A., considers all the various species supposed to exist under the above synonyms identical, the variations arising from cranial structure, and external colouring to be referable to natural or incidental causes, and therefore includes them under the one kind—the Falkland Island seal of Pennant and Shaw, or the Australian fur-seal (*Arctocephalus cinereus*) of Gray. He thus describes the males and females:—

The males, when aged, are whitish-grey, and between 7ft. and 8ft. in length; when adult, brown-grey to black-grey, and about 6ft. in length; young, grey, upper portions soon assume darker colours; pups, black.

The females, when adult, are ash-grey to silvery-grey, at times golden buff, frequently spotted; from 3½ft. to 4½ft. in length, even more when aged; pups, black.

The under-fur of both sexes is rich reddish, diversified by deeper or lighter shades, and variable in length and abundance; the whole being influenced by age, sex, and condition.

By Mr. Forster, the companion of the celebrated Captain Cook, we are told that at Staten Land, where these animals existed in thousands: "As soon as I was near enough I shot the surly creature dead, and at that instant the whole herd hurried to the sea, and many of them hobbled along with such precipitation as to leap down between 40ft. and 50ft. perpendicularly upon the pointed rocks on shore without receiving any hurt, which may be attributed to their fat easily giving way and their hide being remarkably thick. The young cubs barked at us, and ran at our heels when we passed, trying to bite our legs."

Mr. Weddell informs us: "When the Shetland seals were first visited, they had no apprehension of danger from meeting men; in fact, they would lie still while their neighbours were being killed and skinned; but latterly they had acquired habits for counteracting danger, by placing themselves on rocks from which they could in a moment precipitate themselves into the water. Their sense of smell and hearing is acute, and in instinct they are little inferior to the dog. These (the females), in the early part of December, begin to land, and they are no sooner out of the water than they are taken possession of by the males, who have many serious battles with each other in procuring their respective seraglios; and, by a peculiar instinct, they carefully protect the females under their charge during the whole period of their gestation. By the end of December all the females have accomplished the purpose of their landing; by the middle of February the young are able to take to the water, and, after being taught to swim by the mother, they are abandoned on the shore, where they remain till their coats of fur and hair are completed."

A detailed account of the habits of the fur-seal of the Auckland Isles has recently been given by Mr. Musgrave, which he acquired during a compulsory residence in their midst of nearly twenty months. Of the females, he relates that "Their nose resembles that of the dog, but is somewhat broader; their scent appears to be very acute. Their eyes are large, of a green colour, watery and lustreless; when on shore they appear to be constantly weeping. In the latter part of December, and during the whole of January, they are on the land a great deal, and go wandering through the bush, and into the long grass on the sides of the mountains above the bush, constantly bellowing out in a most dismal manner. They are undoubtedy looking out for a place suitable for calving in. I have known them to go to a distance of more than a mile from the water for this purpose. Females begin to breed

when two years old, and carry their calves eleven months, and suckle them for about three months. Before they have their calves the cows lie sometimes in small mobs (from twelve to twenty), as well as while giving suck, and there is generally one or two bulls in each mob. The cows are by far the most numerous." Of the habits of the very young, he says: "It might be supposed that these animals, even when young, would readily go into the water—that being one of their natural instincts, but, strange to say, such is not the case: it is only with the greatest difficulty, and a wonderful display of patience, that the mother succeeds in getting her young in for the first time. I have known a cow to be three days getting her calf down half-a-mile and into the water, and, what is most surprising of all, it cannot swim when it is in the water. This is the most amusing fact: the mother gets it on her back, and swims along very gently on the top of the water; but the poor little thing is bleating all the while, and continually falling from its slippery position, when it will splutter about in the water precisely like a little boy who gets beyond his depth and cannot swim. Then the mother gets beneath it, and it again gets on her back. Thus they go on, the mother frequently giving an angry bellow; the young one constantly bleating and crying, frequently falling off, spluttering, and getting on again; very often getting a slap from the flipper of its mother, and sometimes she gives it a very cruel bite. The poor little animals are very often seen with their skins pierced and lacerated in the most frightful manner. In this manner they go on until they have made their passage to whatever place she wishes to take her young one to."

The males are described thus: "One of a medium size will measure about 6ft. from nose to tail, and about 6ft. or 7ft. in circumference, and weigh about 5cwt. They by far exceed these dimensions. The fur and skin are superior to those of the female, being much thicker. On the neck and shoulders he has a thicker, longer, and much coarser coat of fur, which may almost be termed bristles. It is from 3in. to 4in. long, and can be ruffled up and made to stand erect at will; which is always done when they attack each other on shore, or are surprised—sitting as a dog would do, with their heads erect, and looking towards the object of their surprise; and in this attitude they have all the appearance of a lion. They begin to come into the bays in the month of October, and remain until the latter end of February, each one selecting and taking up his own particular beat in a great measure; but sometimes there are several about the same place, in which case they fight most furiously, never coming in contact with each other, either in or out of the water, without engaging in the most desperate combat, tearing large pieces of skin and flesh from each other. Their skins are always full of wounds and scars, which,

however, appear to heal very quickly. At this place we saw hundreds of seals, both on shore and in the water, which was literally swarming with them, both the tiger and black-seal; but in general the tiger-seal keeps to one side of the harbour, and the black-seals, which are much the largest, the other side; but in one instance we saw a black and a tiger-seal fighting. They were at it when we first saw them. We watched them about half-an-hour, and left them still hard at it. They fight as ferociously as dogs, and do not make the least noise, and with their large tusks they tear each other almost to pieces. There is one seal which we all know particularly well wherever we see him. He appears to be the king of the mob which belong to Figure-of-Eight Island. He is a very large, dark-coloured bull of the tiger breed. We have named him Royal Tom. He is not at all afraid of us when we see him on shore. If the seals round him run away, Tom will not move, and takes very little notice of us. One day the men tried to drive Tom into the water, but he would not move for some time; but after some trouble, I suppose, they got him to start. He went leisurely down to the water, and there he remained scratching himself. Tom had a dry coat, and did not fancy wetting it just then, and into the water he would not go. In going up I found seal tracks nearly to the top of the mountain, which I reckon is about 4 miles from the water, and about 3 miles up I saw a seal. We killed a cow and her calf this morning. We got milk from the cow after she was killed, which was very rich and good, and is much better even than goat's milk. The seals are very numerous here. They go roaring about the woods like wild cattle; indeed, we expect they will come and storm the tent some night. We live chiefly on seal meat; and a one-year-old seal, part of which we had roasted for dinner to-day, was delicious. One instance came especially under my notice of a cow, whose calf had been killed and taken away from her, roaming about the place where she had lost it, incessantly bellowing, and without going into the water, consequently going without food for eight days. After the first few days her voice gradually became weaker, and at last could scarcely be heard. I made sure she was dying. She survived it, however, and on the eighth day went into the water."

Mr. Morris furnished Mr. Scott with the following interesting details of the history of the southern fur seal fishery, and the habits of the animal, which have the advantage of being derived from his own personal experience.

The females, in September, come on shore to pup, and remain until about March. The pups are born black, but soon change to grey, or silvery-grey. The herd go to sea for the remaining portion of the year, returning again in September, with regularity.

During this absence at sea the male pups have changed from grey to a light brown colour, while the females remain unaltered.

In New South Wales the sealing trade was at its height in 1810-1820, the first systematic promoters of which were the Sydney firms of Cable, Lord, and Underwood; Riley and Jones; Birnie; and Hook and Campbell. The vessels employed by them were manned by crews of from twenty-five to twenty-eight men each, and were fitted out for a cruise of twelve months.

The mode of capture adopted was: The men selected for the shore party would number from six to eighteen, this being regulated by the more or less numerous gatherings of the seals seen in the rookery. These men always land well to leeward, as the scent of the animal is very keen, and cautiously keep along the edge of the water, in order to cut off the possibility of retreat; then, when abreast of the mob, they approach the seals and drive them up the beach to some convenient spot, as a small nook or naturally formed inclosure; this accomplished, one or two men go in to the attack, while the others remain engaged in preventing outbreaks. As soon as a sufficient number have been slain to erect a wall of the dead, then all hands rush in to the general massacre.

To so great an extent was this indiscriminate killing carried that in two years (1814 and 1815) no less than 400,000 skins were obtained from Penantipod, or Antipodes Island, alone, and necessarily collected in so hasty a manner that very many of them were but imperfectly cured. The ship Pegasus took home 100,000 of these in bulk, and on her arrival in London the skins, having heated during the voyage, had to be dug out of the hold, and were sold as manure—a sad and reckless waste of life.

Mr. Morris confirms Sir George Simpson and Mr. Musgrave in their account of the affection of the mother for her offspring. "At the time of the slaughter the female utters most piteous cries, alternately looking at you imploringly and then at her young one."

Peron, in 1801 and 1802, found British seamen in Bass Strait, killing all that came in their way.

The schooner Endeavour, from March 9th, 1803, to May 28th, 1804, got 9,514 skins; the schooner Surprise, from March 11th, 1803, to September 15th, 1803, got 15,480 skins. In September, 1803, a vessel brought into Sydney 11,000 skins. The Sydney records, in anything like a full form, are hard to obtain.

During the years 1803 and 1804 upwards of 36,000 skins were sent from the islands in Bass Strait, the slaughter being made without regard to sex or season. On some sealing-grounds the idea was entertained that the female seal alone was valuable, and the result of such faith could only have one end.

"The most southerly group in Australasia," Polack writes, "was discovered in 1811 by a sealing master (who procured a cargo of 80,000 skins of that amphibious animal), and were named Macquarie Islands. A gentleman in Sydney," he says, "procured by means of a sealing party 100,000 skins in one year."

Considering how the seals were slaughtered without regard to age, sex, or season, the wonder is that they have not become extinct long since, instead of preserving a harried and vagrant existence. An eye-witness of their destruction on a sealing-station wrote: "It frequently happens that the number of seals killed in one knockdown is so great that many of them are never even skinned, but suffered to pass into a state of putrefaction. No advantage is taken of the skin whatever . . . and the quantity of oil from each seldom exceeds 3 gallons, worth from 4s. to 4s. 6d. per gallon." How prodigal men were, sealers and whalers alike, of animal life, finds a record in New Zealand in later years. In 1835 a party of whalers established themselves at the mouth of the Mataura River, and killed eleven whales in seventeen days; but all the oil was lost as no casks had been sent them. Profiting by experience, which the whalers had not done, when the casks came no whales were to be found, and the station was abandoned.

In 1821 and 1822 the take of seals by British sealers at the South Shetlands was 320,000 for the two years. Males and females were killed indiscriminately, and the young left to die. Then came the Americans to finish the work we had so well begun. Armed with every engine of slaughter that ingenuity could devise, they cruised, like the buccaneers of old, up and down in the south seas, visiting and setting down upon their charts every island, reef, or rock. Every living thing that had fur, hair, or blubber on its body they killed. Seals had become scarce so early as 1835, when regular sealing in large parties at given localities had ceased to be profitable; and men were then left "to watch out" and shoot the animals as they came on shore.

In 1821, a vessel called the General Gates left Boston, U.S. On the 10th of August following five men and a leader named Price were landed near the S.W. Cape of Te-Wai-Poenamu (the Middle Island). In six weeks they got 3,563 skins. Nicholson, who accompanied Marsden to New Zealand in 1814, was keen to observe the importance of the seal trade to New South Wales, and writes: "The ursine seal, or the sea-bear, and the sea-lion are found in congregated herds to the southward, and on Campbell and Macquarie Islands, which are situated at no great distance from the southern part of New Zealand. The valuable furs of these animals are found in great plenty, and are now made by the colonists of New South Wales a most profitable article of commerce." Writing in 1836 or 1837, Polack says: "Some fifteen

years since, seals were abundant on the southern parts of the country, · · · but so few are now procurable that a single vessel employed solely in this trade would make a losing speculation." Salted seal-skins were found in the hold of the Boyd; and Mr. John Jones, of Waikouaiti, began work and thrift, it is stated by Shortland, in these waters as a boy sealing. These details are collated to show how wide the profits on sealing were before we took possession of New Zealand, and how expanded our sealing may, under wise legislation, again become.

Seals had a wider range in earlier days along our coasts than their descendants enjoy. Their bones are found in the middens at Whangarei. Polack tells us how the Natives on the East Coast captured one at Poverty Bay when he was there in 1836, affording them, as it did, a rich treat. Kennedy says they were found in Cook Strait at an early period in immense numbers; while Dieffenbach, in 1839, states that only a straggling animal was occasionally seen in Cook Strait. Cook, it will be remembered, says the largest seal he had ever seen was on the excursion to the east, and notices in Charlotte Sounds a sea-lion rise twice near the shore. Polack says the favourite grounds of the seals were the whole of the west coast of the Middle Island, from Cape Farewell to the South Cape, including the rocks called the Traps, the Snares Islands, the Antipodes Islands, and the Chatham group. Heaphy, at a much later date, writes: "The seal parties were located at Port Pegasus, Dusky, Jackson, Daggs, Milford, and Teramakau, in the greenstone country; and they visited in their boats the Black Reef, or Three Steeples, off the mouth of the Buller; Toropuhi, near Rocky Point; and the Brothers Rocks, in Cook Strait. In 1846," he adds, "I walked along 300 miles of the west coast of the Middle Island, passing the Black Reef and Toropuhi. There were pieces of English oak and fragments of copper on the beaches, indicating where one of the sealing ships had been wrecked, and the starving crew eaten by the bush Natives. At Toropuhi there were three seals on an offshore rock, stretching out their necks and ungainly heads to look at us. They were the last remnants of their race."

The American fur-seal had a narrow escape of sharing the fate of its southern kindred. Early in this century the seals were almost exterminated in many islands of the North Pacific, and were there as ruthlessly slaughtered as they were in Bass Strait and the New Zealand coast. Their extermination was, as it were, commenced, had not Russia first and the United States afterwards leased the exclusive right of killing seals on the Pribilov Islands—a famous sealing place—to a single company, by which means the seals were saved, as the company had an interest in keeping up the supply of furs. This single experiment has proved conclusively that fur-seals can be farmed as easily as sheep, and that

sealing should not be thrown open without restrictions. Seals are a property the State should jealously guard. St. Paul Island, which is the largest of the Pribilov group, has a superficial area of about 33 square miles only of rough and rocky upland and small hills. It has 42 miles of shore line, some 16 of which are used by the seals. It is in latitude 57° North. St. George is the next island in importance, and has an area of 27 square miles only and 29 miles of coast line, of which only some 2½ are used by the seals. It is important to bear these details in mind, because it will be noticed that our Auckland Islands far exceed the two islands above mentioned in area many times over, and it is questionable whether Campbell Island is not equal in area itself to St. Paul, in Alaska. Nor in this connection should it be forgotten that from the depôt at the Antipodes, in the two years 1814 and 1815, as mentioned elsewhere, 400,000 skins alone were obtained.

To the two Pribilov Islands before mentioned it is computed that over 5,000,000 seals resort annually. The first arrive there in May and the last leave in October. It is not known where they winter. Mr. Hittell says: "The value of the fur-seal grounds on the Pribilov Islands was discovered in 1786, and had a potent influence in inducing the Russians to extend their authority over the group as well as over Alaska. The slaughter of the seals was prosecuted without check until 1839, when the number had been so reduced that the business threatened to be entirely destroyed within a few years. The destruction was then stopped until 1845, when it was gradually resumed, though, instead of the indiscriminate slaughter which had before been permitted, only the young males (two years old) were allowed to be killed. The rookeries continued to increase in size until 1857. At that time the entire fur trade of the islands was in the hands of the Russian-American Company, established in 1799, and the company was restricted about 1860 by the Government to 50,000 seal-skins annually. Of these, 5,000 or 6,000 were from St. George, and the remainder from St. Paul. At one time this company had a contract to deliver 20,000 skins annually to a New York firm, at 2 dollars 50 cents each. The Natives supplied the skins in condition for shipment at 10 cents apiece, no other outlay being incurred by the company except the cost of salt for the curing process. From 1821 to 1839, 758,502 fur-seals were killed, and 372,894 from 1845 till 1862."

And here in this highly important narrative we may pause to consider the wisdom of the regulations enforced. Only young male seals were allowed to be killed, the females being properly preserved for breeding. It was the leaseholders' interest to preserve the females, and to see that they were protected. It was only by leasing the islands that they could be thus preserved,

unless their preservation took the form of treaty, as only by the establishment of a sealing monopoly, such as is here described, could strangers be prevented from sealing, and the female seals preserved. But to resume Mr. Hittell's narrative :—

"When the United States Government took possession of the islands in 1867, the Russian-American Company ceased to exist, and several American firms established themselves in Alaska for the purpose of trading and seal-fishing; and the wholesale slaughter of seals began afresh. In 1868 not less than 200,000 seals were killed, and for 1869 the figure was not far below 300,000. Skins were then sold in San Francisco 5 dols. 25 cents, and the Natives were paid 35 cents apiece. The Government, fearing their total extinction, or their being driven away, leased, under an Act of Congress dated July 1, 1870, to Hutchinson, Kohl, and Co. (incorporated under the name of the Alaska Commercial Company), the sole right of seal-fishing on the islands of St. Paul and St. George. The annual rental was fixed at 55,000 dollars, and 2 dollars 62½ cents for each skin taken from the island, restricting the allowed number to 100,000, of which 75,000 were to be taken from St. Paul, and 25,000 from St. George. This last condition was amended in 1874, in so far that the amount to be taken from St. Paul would be henceforth 90,000, and 10,000 from St. George. The company stipulated that the Aleuts should receive 40 cents for killing a fur-seal, and extra pay for salting."

A seal may be roughly described as a flesh-eating mammal inhabiting the sea in which it obtains its food; and curious blunders were made by our forefathers who regarded it as a fish. They were constantly betrayed into breaking their Lenten fast under the belief that the seal, porpoise, and whale were food for fast days. High prices, we are told, were paid for such meats, and porpoise-pudding was a dish of State as late as the sixteenth century. Statutes exist of the previous century restricting the consumption of porpoises, seals, and grampus, as meats too dainty for the million. Cook, writing of the seals killed in Dusky Bay, says: "These animals served us for three purposes. The skins we made use of for our rigging, the fat gave us oil for our lamps, and the flesh we eat. · · · The flesh eats little inferior to beef steaks." Writing more than 100 years afterwards, Captain Temple, in the *Fisheries Exhibition Literature*, says: "The flesh of the pup seal, when six weeks old or more, is esteemed by seal hunters as equal to the best mutton if properly cooked. The flesh of the yearling seal is somewhat darker than beef; it is juicy and tender, but lacks the sweetness and flavour of beef, and is less firm and nutritious." When the Chatham Islands were first discovered, the aborigines were clad in seal-skins, and seal-flesh was as highly prized by them as by the New Zealanders.

A few paragraphs on the habits of seals are necessary to aid in conveying a clear idea of what may be done to ensure their multiplication. The following details are largely taken from Mr. J. Clark's paper, in the *Contemporary Review* for December, 1875. Mr. Clarke writes: The male seal does not attain his full size till he is about six years old, and the female when she is about four. There is a remarkable disparity of size and build between them. In a species where the male would be 7ft. or 8ft. in length, and weigh 500lb. to 700lb., the female would not be more than 4ft. long, and weigh from 80lb. to 100lb.

The female also differs from the male by having a somewhat longer head, shorter neck, and a greater fulness of body posteriorly. Her colour when she first leaves the water is a dark steel mixed on the back, the sides and breast being white; but she gradually changes somewhat, and in eight or ten days after landing becomes dark brown on the back, and bright orange on the breast, sides, and throat; hence it is easy to distinguish those that have just arrived from those that have been several days on the shore. The female breeds the third year, and is full grown at four years.

The yearlings weigh from 40lb. to 50lb., and are dark brown, with a lighter shade on the throat and breast. The ages of those between one and six years old are easily distinguished by the difference in size and state of development of the animals. The reproductive organs of the male are fully developed the fourth year, and it is mainly by males of this age the fertilization of the females is effected. Steller gives the number of females to each male as eight to fifteen or even fifty; while the seraglios of the sea-elephant are said to contain from fifteen to twenty females.

The female has four teats—two on each side, equi-distant and in line between the fore and hind flippers. Their milk is of a yellowish colour, composed of water and caseine, very insipid, and containing no sugar. The pups nurse but seldom, and when separated from the mother for thirty-six hours and return to her again, they seem in no haste to do so, and in some cases did not for several hours afterwards.

The voice of the male is compared to the roaring of the lion, that of the female to the bleating of a sheep, and that of the young to the cry of a lamb. Steller says: "When this animal lies upon the shore and diverts himself, his lowing is like that of a cow; when he fights he growls like a bear, and when he has conquered his enemy he chirps like a cricket."

Bryant writes: "In a few days after the birth of the young, the female is ready for intercourse with the male. She now becomes solicitous for his attentions, and extends herself on a rock before him. Owing to the position of the genital organs,

coition on land seems to be not the natural method, and only rarely—in perhaps three cases out of ten—is the attempt to copulate under such circumstances effectual. In the meantime the four and five-year-old males are in attendance along the shore. When their jealous lord is off his guard, or engaged in driving away a rival, the female slips into the water, when an attentive 'bachelor' seal follows her to a distance from the shore. Then breast to breast they embrace each other, turning alternately for each other to breathe, the act of copulation sometimes continuing from five to eight minutes. When the female again returns to the shore she is treated with indifference by all the males."

The ground occupied by them, called a rookery, is the space between the high-water line and the foot of the cliffs. The sandy beach is used as the play-ground for the pups, and the uplands at the top of the cliffs as their sleeping places. The arrangement of their dominions is adopted by common consent, and enforced by the elders with much severity. The old males and the full-grown females are alone allowed upon the rookeries; the young seals swim about in the water, or, in favourable weather, retire to the uplands, behind the rookeries, sometimes at the top of cliffs 120ft. high. Passages through the rookery are appointed, and regarded as neutral ground, through which a continuous line of seals moving down or up may be seen. So long as they keep the path they are unmolested, but woe betide any unfortunate youngster who, prompted by curiosity, may stray to the right or left. The Natives of the Pribilov Islands call the old males "married seals," the old females "mothers," and the young males "bachelors." During the winter months the rookery is entirely deserted, except by a few stragglers. Probably, these annual migrations are more regular in one place than in another, depending on the temperature.

Hittell tells us that the so-called bachelor seals are compelled, when they visit the island, to stay away from the breeding grounds, and thus nature keeps separate those seals which can be killed without disturbing the peace of the grounds where the stock is perpetuated. In the early part of the season large numbers of the young bachelors go ashore, not far from the water, and while they dose there the men approach quietly, and get quickly between them and the sea. In this way a dozen men, running down a long sand beach, will turn thousands of seals away from the water. When the seals are first startled they arise, and, seeing the men between them and the water, immediately turn, and lope and scramble away over the island. The Natives then walk leisurely on the flanks and in the rear of the drove thus secured, and direct and drive them to the place of slaughter. Care is taken not to kill more seals at a time than

the force of men employed can dispose of properly, as fifteen minutes' exposure to the sun will spoil the skins by loosening the fur. The skin is immediately salted after being removed. The salt-houses are arranged with large bins of thick planks, into which the skins are put, with a layer of salt between each layer of skins. They become sufficiently cured in from five to seven days, and are then taken from the bins, and piled up with a little fresh salt. Finally, they are prepared for shipment by rolling them into compact bundles, two skins in each, securely lashed. The largest of these bundles weigh 64lb., but their average weight is but 22lb. The smallest skins taken from seals two years old weigh about 7lb., and the largest from seals six years old, about 30lb. The same writer adds: "All the fur-seal skins on our (Californian) coast are sent in a raw condition to London, the only place possessing the skill requisite for dressing and dyeing them in the best manner, so that they shall sell readily for 40 dollars, though the raw pelt is worth there only 15 dollars or 20 dollars. France has imported artisans, dye stuffs, and even water from England, but has never made furs equal to those prepared in London. The methods of drying and dressing are kept secret, but the main processes are these: The skin is soaked in warm water, scraped clean, soaked in warm water containing mahogany or rosewood sawdust, and trodden by human feet for several days, thus cleansing the hair from sticky substances. The second process is to shave off the inside of the skin, so as to cut off the roots of the coarse hairs, which project beyond the delicate fur. The latter retains its hold, while the coarse hairs fall out after the skin has been shaved. The third process is the dyeing, and this is the chief secret."

It is the dyeing process which causes the fur to lose its natural curly character, and to present its limp appearance.

At the beginning of spring the chiefs of the herd make their appearance in the water, near the island, and swim about with much caution for several days. If it all appears safe they climb on to the rocks, and examine the state of the rookery, carefully smelling about, with every appearance of shyness and unwillingness to leave the water. These are the most adventurous, and generally the oldest males of the herd; they are never less than six years old, and often three or four times that age. Between the first week of May and the 1st of June very few are added to the pioneers. Then, however, if summer weather has set in, which, at the Pribilov Islands, means a succession of warm, sunless fogs, the bull-seals come up by thousands, and locate themselves in advantageous positions for the reception of the females.

It appears to be well understood among them that each able-bodied bull is to have a piece of ground about 10ft. square to himself, provided he can hold it against all comers. To maintain

their position they wage desperate conflicts, the opponents seizing each other with their powerful teeth and tearing deep gashes in the body, or shredding the flippers into ribbon-strips. A veteran has been known to fight as many as sixty victorious battles for a coveted position on the water-line. The vanquished withdraws humbly, and is never followed by his conqueror, who sits complacently fanning himself with his hind flipper, awaiting the next attack. It is said that occasionally those few males who have been vanquished in all their encounters, and are therefore unable to obtain a resting-place or a wife, retire together to some distant beach, there to bury their shame far from the society of their fellows, where they sit together gloomily, grievously wounded in body and in temper.

Captain Weddel, writing of the Southern fur-seal (*Arctocephalus Falklandicus*) in Shetland, says: "They are in their nature completely gregarious, but they flock together and assemble on the coast at different periods and in distinct classes. The males of the largest size go on shore about the middle of November to wait the arrival of the females, which of necessity must soon follow, for the purpose of bringing forth their young. During the latter end of February what are called the dog-seals go on shore; these are the young seals of the two preceding years, and, as such, males, as from their age and want of strength, are not allowed to attend the pregnant females. These young seals come on shore for the purpose of renewing their animal coats, which, being done by the end of April, they take to the water, and scarcely any are seen on shore till the end of June, when some young males come up and go off alternately. They continue to do this for six or seven weeks, and the shores are then abandoned till the end of August, when a herd of small young seals of both sexes come on shore for about five or six weeks; soon after they retire to the water. The large male seals then take up their place on shore."

Returning to the Northern fur-seal, Mr. Clark says: "Between the 12th and 14th of June the first of the cow-seals come up from the sea, and the bulls signalize their arrival by a universal, spasmodic, desperate fighting among themselves. The cows, which form by far the largest proportion of the herd, arrive nearly all together; and those who have been fortunate enough to witness one of the annual migrations describe in glowing language the appearance of the vast herd at sea, leaping and plunging through the waves. With the arrival of the cows begins the duty of the bachelors. They swim all day along the shore, escorting the females to the beach, and driving them up on to the rocks as fast as they arrive. Some of the older females seem to be aware that they are going home, and are on the look-out for some particular male. Such an one may be seen

to climb the outlying rocks that overlook the rookery, calling out and listening as if she expected a familiar voice to reply to her. As soon as a female has appeared upon the sand, the nearest male goes down to meet her, making a noise like the clucking of a hen. He bows to her and coaxes her until he gets between her and the water, so that she cannot escape. His manner then changes, and, with angry growls, he drives her up to his resting-place.

"It is, however, little likely that the poor defenceless creature will be allowed to stay there quietly; for, while the bulls in the rows nearest the water are making their choice, those in the next row higher up watch for an opportunity to steal the wives of their more fortunate neighbours. This they do by taking them in their mouths and lifting them over the heads of the other females, as cats do their kittens. The same method is pursued by the males in the other rows till the whole space is completely full. Not infrequently one female has the misfortune to attract the attention of two males at the same time, the consequence of which is that she gets terribly lacerated and sometimes torn in two. When all the females have been landed and distributed among the claimants, no further change takes place, each sultan walking round and round his family, complacently surveying it, and fiercely driving off all intruders. Each of these polygamous sultans attaches to himself from twelve to fifteen wives, provided he gets a station well to the front; if he is in one of the back rows, he probably gets only from five to nine. Mr. Elliott once counted as many as forty-five under the charge of one bull, who had penned them up on a flat table-rock, accessible at one point only. There the old Turk took up his stand and guarded his stronghold right well against all intruders. It will please modern sanitary reformers to learn that they dislike wet or slushy resting-places, and invariably select a position with due regard to its drainage.

"By the 14th of July the cows have all arrived. In character as well as in appearance they form a striking contrast to the bulls. They never fight or quarrel with each other, and never or seldom utter a cry of pain or rage when roughly handled by their lords.

"In a few hours after the landing of the mothers the pups are born. At birth and for the next three months they are of a jet-black colour, weigh from 3lb. to 4lb., and are about 1ft. long. Twins are rarely if ever seen. The mothers show but little fondness for their offspring, never caressing or fondling them as other animals do; but they can distinguish their cry among all the din of the thousands of precisely similar little creatures on the shore, and will on no account suckle any other pup than their own. It does not, however, appear that the pups know their own mothers.

"By the end of the first week in August, at the Pribilov Islands, the young have all taken to the water, and the veteran males, regarding their duties as ended for the season, go down to the sea to feed and wash, the latter operation being quite as necessary as the former. Attention must here be drawn to the extraordinary fact that during the whole of the previous three months the males have never left their positions for an instant, day or night. During this long period, therefore, they have tasted neither water nor food of any kind. This strange abstinence would be remarkable enough under any conditions, but it is simply wonderful when we remember that during the whole time the bulls are in a state of restless activity, hardly quiet for a moment, night and day, jealously guarding their wives and families. When August comes they are by no means emaciated, as might be expected. They have lost their fat, but are still in good flesh. This statement has been verified by several observers in the North, and confirmed by numerous travellers in the South. I have been told myself, by a gentleman who had an opportunity of observing the great sea-elephant (a true seal) on Kerguelen Land, that they arrive very fat, remain on shore without eating a morsel for two months, and depart, as might be expected, considerably leaner than they came. It is thus evident that they subsist by absorption, consuming the fat of their own bodies.

"The young being able to take care of themselves, the rookery is broken up. The veteran males go into the sea, and do not, as a rule, return to the land at all. The vacant rookery is taken possession of by cows, pups, bulls, and bachelors of all ages. The cows abandon their young almost entirely, lying out in the rollers, where they lazily turn over and over, scratching their backs and sides with their hind flippers, in a state of the most complete languor and placid enjoyment. The pups 'haul up,' as it is termed, along the beaches right and left of the rookery, and gambol together all day long. The bachelors—the most restless animals imaginable—either frolic on the land or display their wonderful activity in the water.

"About three months of this peaceable existence, and the seals begin to leave. By the middle of November the greater number have departed. A few, however, stay there till they are driven away by snow and rain, both of which are very disagreeable to them."

Seals are, however, allowed to be killed indiscriminately in the North, in British possessions. What can be thought of proceedings such as those described by Captain David Gray, of Peterhead, an experienced sealer! It was only in 1875 that he wrote: "Last year the fleet set to work to kill the seals on the 26th of March, and in forty-eight hours the fishing was completely over, the old ones being shot, wounded, or scared away, while

thousands upon thousands of young ones were left crying piteously for their mothers. These mostly perished of famine in the snow, as they were not old enough to make it worth the trouble of killing them." Nor are such examples in any respect isolated cases where inspection of sealing parties is imperfectly carried out.

With the Alaska Company the mode of slaughter is different, as we have seen. When rounded up on the field of blood, they pass through a careful inspection, the old bulls being allowed to drop out, care being taken previously to exclude females from the herd, or "food." "When," Mr. Clarke says, "the seals have reached the killing-ground, they are allowed a certain time to cool, after which about 100 are driven together into an enclosure, and the fittest are selected for slaughter. The others are allowed to go down to the nearest water, when they at once make their way back to the sea. The instrument of destruction is a long club of hard wood, with which the animals are struck a violent blow on the head. One is usually sufficient. A long, sharp knife is then thrust into the vitals, and the carcass is laid aside;" and so on until a number have been slain, when the work of skinning commences. Mr. Earll (United States Commissioner at the Fisheries Exhibition) described the Natives as wonderfully expert in taking off the skins; several, he says, were stripped in the course of a minute. In other places, as at Magellan and in Spitzbergen, the gun is used as an implement of destruction, but the most humane and profitable method is that adopted by the Alaska Company.

A fair description of the mode in which sealing is carried on in New Zealand, is given by the late Major Heaphy in the following words: "Suddenly the headsman makes a sign for 'oars,' and they are laid in noiselessly, the bow oarsman previously ascertaining the depth of the water, which he quickly intimates to the headsman; the grapnel is dropped over the bow at such a distance that the boat shall not touch, and, taking our clubs and lances, we wade waist deep in the water to the rocks. It is not yet sufficiently light to discern whether there be any seals, but we think we can hear their grunting. It is very cold; blowing from the south right into us, with no shelter but a shelf of rock, and even smoking prohibited. In half-an-hour or so it becomes light enough to discern objects, and we suddenly hear shouts from the opposite side of the reefs. It is the captain's party starting the seals. We get to the top of the reef as quickly as possible, and right in the front of us, almost as thick as a drove of sheep, but each taking its own way, come the seals. Striking, spearing, right and left; some of the seals making, like pigs, between one's legs, with here and there a tumble and a roll. The captain and his party are following them closely, and by the time the last has reached the water, seventy-six seals are lying dead or stunned on the reef."

Comment or comparison between the different modes of seal fishing is plainly superfluous.

Captain Fanning, we are told in the *Fisheries Literature,* who was a noted sealing master in early times, distinguished the different ages and sexes of the fur-seal as follows: "Full aged males called wigs; the females, clap matches; those not quite so old, bulls; all the half-grown of both sexes, yearlings; the young of nearly a year old, grays, or silvered pups; and before their coats are changed to this shade, black pups."

"It will be seen," writes Captain Charles Bryant, "by the foregoing description of the habits of the fur-seal, that the conditions necessary for their preservation and increase are very simple. The first is that they be not unnecessarily disturbed during the period of their arrival on the island; second, that care be taken in killing, to kill only males, and to reserve enough of these for breeding purposes. If these precautions are taken, they increase faster than if left to themselves, for when the number of males is in excess, the continual fighting on the rookeries destroys many of both females and young, which get trampled to death. Besides the skin, each seal will yield 1½ gallons of oil."

Captain W. J. Grey, writing to the Secretary of the Marine Department on the 29th of March, 1881, says of his voyage in the Stella: "It is only a few years since all the west coast of New Zealand was full of seals (rather, perchance, an exaggerated statement), but there is not one to be seen now; neither did we see any at the Auckland Islands during the whole time we were there. Unless sealing is put a stop to for at least two years the seals will be driven out altogether. Most of the sealers say themselves that it will be a good thing, and it would give the seals a chance to come round again." The following year it may be noticed that Mr. Seed assessed our seal trade export annual value at £8,000.

From the year 1853 onwards the export of seal-skins from New Zealand has been of a very irregular character, as the following details from the *Statistics* will show: In 1855, from Wellington, 580 skins were exported; and in 1857, 376; when no further record of exportation is found until 1868, when the years and numbers run as follow: 1868, 675; 1869, 14; 1870, 269; 1871, 755; 1872, 2,012; 1873, 1,602; 1874, 1,061; 1875, 2,767; 1876, 3,417; 1877, 1,503; 1878, 820; 1879, 2,484; 1880, 2,648; 1881, 1,259; 1882, 353; 1883, *nil*; 1884, 374. It is worthy of notice that the party landed from the General Gates, in 1821, got more skins in six weeks from the south end of the west coast of the Middle Island alone than have been exported from all our sealing grounds during any one year since 1868.

THE SEA LEOPARD (*Stenorhynchus Leptonyx*).

SYNONYMS—*Phoca Leptonyx.*
The Small-nailed Seal.
The Leopard Seal.

In no group of mammalia in the world, we are told, does more remain for further investigation than in seals, and more especially does this seem the case with the leopard-seal. Whatever species it may be assigned to, there is little doubt but that it belongs to the *Phocidæ* family, which includes the common seal, the monk-seal, the ringed-seal, and many other actual or imaginary varieties in its numbers. With the hope, then, of obtaining fuller information on the seals on the west coast of the Middle Island and on the outlying islands of the Colony, some details describing the leopard-seal and others are here given that would not, perhaps, be expected to be found in a handbook compiled for popular use. Thus the *Phocidæ* family is described in the following manner by Mr. Scott: "Hind limbs, when at rest on land, are directed backwards nearly in a line with the body, by the integuments of which they are enveloped and confined as to possess but little or no power of motion, the feet being capable of moving only in an obliquely lateral direction. The progression on land, therefore, is effected by means of the abdominal muscles and flexible spine, assisted materially by the front limbs. In many other important portions of their structure they likewise differ greatly from the eared seals. The skull is but moderately crested; the shoulder-blade is reduced in size; the pelvis is comparatively small, and in its form it exhibits no unusual sexual difference, being alike broad in both sexes; and the pelvic bones are thin and slender. The hair which clothes the body is short, closely pressed against the skin, more or less soft and woolly, and extensively used in the manufacture of articles of wear, although greatly deficient in quality to the under-fur which distinguishes the fur-seal of commerce." The fur-seal belongs to the family known as *Otariadæ*.

GENUS.—Incisors conical, the outer upper ones large, resembling canines, one species excepted; molars distinctly trilobate, anterior one in each ramus single-rooted, the others with two roots; muzzle simple, hairy between and above the nostrils; whiskers small, wavy, tapering; claws of fore feet small, of hind feet obsolete, or nearly so.

Captain Musgrave, who was cast away on the Auckland Islands, and kept prisoner there for some eighteen months, has given us in his narrative a large amount of information concerning the seals in that portion of the Colony. From the first perusal of his journal it would appear that there were at least three varieties of seal on the islands, but closer consideration of his

statements hardly bears out the first impression. In page 7 he writes: "In general the *tiger-seals* keep one side the harbour, and the *black-seals*, which are much the largest, the other side." In the next paragraph he says: "We also saw a sea-lion; he was very large, and had been fighting;" but, in the first appendix to the journal, which is described as "An Account of the Sea-lion and its Habits," the leopard-seal seems to be indicated. That there were two kinds of seal on the island is certain, as on page 9 he writes: "We only eat the cow and calf of the tiger-seal; the black-seal is not good." The tiger-seal is most probably what is known as the leopard-seal, and supplied Captain Musgrave and his companions with food for many months, and a portion of the journal he kept was written in seal's blood. There are certain facts to be gathered from his observations which are valuable from an economic point of view. There is no trouble whatever in distinguishing the male seal from the female. The seals can run very fast in the bush. The journal commences on 30th December, 1863, and on February 21st, 1864, there is this entry in it concerning the wreck: "I could have loaded her with skins in a month, and should have been in Sydney before this."

At this time, it will be remembered, the New Zealand export of seal-skins was an unknown quantity. The bulls of the leopard-seal are aggressive. Thus detailing what happened when hunting for young seals for their larder, the writer says: "One of the men was at this moment attacked by the only remaining one, which was a tremendous large bull—the largest tiger-seal I have seen (they were all tigers)—and he fought like a tiger." In this case they stole on three mobs of seal asleep, thirty or forty in each mob, and among them a great many young calves, which they wanted to get without killing the old ones. In ten seconds they knocked down ten calves from two to three months old, and one two-year-old seal. Soon as the seals were awake, young and old rushed away to the sea, save the old bull above mentioned. This was in March. In the same month, but later, he writes: "We had a few hours of moderate weather on Friday, March 18th, and we went to Figure-of-Eight Island, and found the seals, both young and old, very numerous; but this time we had a regular pitched battle with some thirty or forty of them on the beach. We vanquished them and got seven young calves. There were four of us; Mr. Raynal had the gun, but I did not want him to fire at them if we could avoid it. · · · We killed a number of old ones, but these we had to leave, as they would only have been an encumbrance to us, and the seals were running around in such numbers and in such a threatening manner that we hurried away as fast as possible. There was a great number of young ones left on the island, and there is no doubt but they would have landed with increased numbers and attacked us again." In

the same entry we find the following: "When you surprise the calves, when they are staying at the edge of the water, they will always run on shore and make for the bush. The last time that Raynal went without me the seals were very savage. In the water they attacked the boat. One left the marks of his teeth in an oar, and another was going to jump into the boat, but Raynal shot him. When they are killed in the water they sink like a stone." At the end of March the captain says: "We did not see any seals on shore, but we saw great numbers in the water." On May 1st there is an entry of the captain and his men going to the same island for "fresh meat," but there were few seals on shore. "It was flood tide, and I find that this is their fishing time. . . . Certain mobs collect and camp on their own particular ground, and also keep together in the water, but do not confine themselves to any particular part of the harbour. This I have ascertained from observation." Early in June the seals had deserted the island, and when the party searched it for fresh meat in vain they found the seals had not been there for some time. There is no doubt about the accuracy of these details, because food and life to the shipwrecked men depended on the seals; and the extracts here given are preferable to tomes of scientific speculation. On June 20th the writer says: "On Monday morning two of the hands went before daylight to a place where we knew a mob of seals frequent in the night. They found great numbers on shore, and just as the day began to break they began to go into the water. They killed two cows. It is evident that they only come up for a few hours in the night to sleep, and stop in the water all day." At the end of July, complaint is made of the difficulty in finding seals, "for every time we kill any they shift their camp." Up to the end of August seals were on the islands in numbers when they could be found, but they became migratory from constant molestation. Early in September the bulk of the seals appeared to have left the island, and black-seal generally had to be taken for tiger-seal to supply the larder of the castaways. In October they killed a calf, about four months old, "the only instance that we yet found of their having calves later than January." December he considers the month in which they generally calve. In November the bulls returned fat and fierce, just apparently in time to save the castaways from starvation, and the same entry which announces their arrival takes us round the year, giving us the benefit of the record of twelve months' observation. November and December appear to be the time of the arrival of the main body, and May and June that of their departure. If some of the details here given concern a variety of fur-seal instead of the leopard-seal, the information has the merit of being faithful, even if misplaced, and the very fact of its misapplication may be the cause of more precise inquiry.

The whole subject seems very complicated, and reminds the inquirer that there are no less than nine different kinds of seals taken in the antarctic waters, and that one of the seals on the Auckland Islands described by Captain Musgrave is called Hooker's sea-bear, and classed as *Otaria Hookeri*, thus transferring it from one family to another—a matter, after all, of little importance, save to scientific men. The only object of noticing the seals on our coasts and islands at all is the hope that the Government of New Zealand may expend as much care and energy in conserving a native and established industry as it displays in fostering others that are, as it were, foreign to our environments. Seal-farming is as practicable as sheep-farming, and far more profitable when properly conducted.

The sea-leopard has been so named on account of its spotted appearance, the general colour of which is a silvery-grey, washed with yellow. The markings are irregular, sometimes lighter than the ground colour, with a dark border, and a few uniform black spots interspersed. Young specimens and females occur without them. It attains in some cases the length of 12ft.

Captain Hutton says it is found on ice-floes in the antarctic seas, and occasionally in Australia.

Dr. Gray writes: "The following notice of this species has been kindly communicated to me by Dr. Frederick Knox, with a skeleton and part of the viscera, which was caught on the coast of New Zealand: 'It was of a dull yellow olive colour, irregularly spotted. The nostrils opened much after the manner of the cetacea, in the form of the elongated fissures, 1½in. from the extremity of the snout; whilst the position and vast size of the pelvic extremities, added to the extreme shortness of the tail, so nearly approached in form and appearance the lateral flanks of the tails in whales as to deceive any one but a comparative anatomist. The specimen was shot and captured in Evans Bay, Port Nicholson, in November, 1843. The skin was hairy. The stomach of the seal contained numerous fish-bones, a few feathers (gulls'), and some considerable portions of a pale green, broad-leaved, marine fucus. Thousands of a small, hard, round, white worm (parasitical) pervaded all parts of the intestines.'"

Another specimen, a female, was obtained in October, 1870, at Double Bay, near Sydney, and kept alive for several days in the Museum grounds, where it fed on grass, no other diet being at hand. The narrator of the fact adds that it is not certain that a fish diet is absolutely necessary for the subsistence of this animal.

Professor Scott, who found it on Macquarie Island, says it is the terror of the penguins there.

SEA ELEPHANT (*Morunga elephantina*).

SYNONYMS.—*Macrorhinus proboscideus.*
Macrorhinus elephantinus.
Phoca elephantina.
Phoca proboscidea.
Mirounga ansonii.
Cystophora proboscidea.

The sea-elephant, in the language of scientific men, belongs to the family *Cystophoridæ* and the genus *Macrorhinus*, and is thus described: First, as to family: Outer incisors large, formed like the canines; molars, with small compressed crowns and greatly swollen single roots; head short, broad; muzzle of the males furnished with a dilatable bladder-like appendage; whiskers long, thickish, waved, obtuse at their tips; nostrils large; eyes large, prominent; nails elongated, pointed, obsolete in the hinder feet of the *Macrorhinus*; tail very short. The animals, during progression on land, move principally by means of the abdominal muscles and extremely flexible spine, assisted materially by their flippers. In repose, the hind limbs are stretched backwards in a line with the body. In habits, polygamous and gregarious.

GENUS.—The adult males possess the power of elongating the nose into a tubular proboscis, resembling somewhat the proboscis of the elephant. In the female this dilatable appendage is undeveloped. Forehead convex; hairs of the whiskers very long, large, roundish, and slightly waved; similar hairs in tufts over each eye and on each cheek; fore feet with longish claws, the first one being the smallest; hind feet with the outer toes large, the three middle ones small, all of them without nails; eyes large and prominent.—(Scott.)

The same gentleman writes: The sea-elephants retain the semi-terrestrial habits of the eared seal, although they differ so materially from them in the structure of their posterior extremities, these becoming so confined within the integuments of the body as to possess but little or no power of motion.

This cramped condition of the hinder limbs, common to the whole of the seal tribe, with the exception of the eared seals and the walrus, is in this species slightly mitigated by the thick and stout form of the pelvic bones, which permits a freer use of these members; and by the greater expansion and stoutness of the shoulder-blades, which strengthen the flippers and render their assistance more effective, so that a power of locomotion on land is attained of an intermediate character between that exhibited by *Otariadæ* and *Phocidæ*.

The sea-elephants were formerly found in great abundance inhabiting many of the numerous islands lying between the thirtieth degree of south latitude, even to the verge of the antarctic circle, as Juan Fernandez, Staten Island, Falkland Islands, South Georgia, Tristan d'Acunha, Kerguelen Land, and other spots where sandy beaches and fresh-water swamps exist—a geographic range so vast as to comprise at least two-thirds of the whole area of that portion of the Southern Seas comprised within the latitudinal belt above specified. Their powers of locomotion, however, are so great that frequent stragglers have been captured on the coasts of Australia.

In fact, it appears that this animal affords another illustration of the extensive habitat originally enjoyed by certain species, such as the sea-lions and the seals of commerce of the North and the South, until driven away by continuous persecution to seek the more restricted and outlying homes adequate for their reduced numbers.

Professor Scott writes in *The Transactions of the New Zealand Institute* as follows (vol. xv., pp. 484, *seq.*): "In most of the maps which I have seen, an island named Emerald is put down in latitude 57°, a long way to the south of Macquarie Island. This is, however, now generally regarded as mythical, for its supposed site was sailed over by the Transit of Venus Expedition, and no land was discovered. · · · We may therefore safely consider that Macquarie Island is the most southerly island of the outlying members of the New Zealand group."

Its position is generally stated as 54° 19′ S. and 158° 48′ E. Mr. Scott, in the latter end of 1880, visited the island in the Jessie Niccol, wishing to notice how many members of the New Zealand flora survived in that high latitude, and what changes in appearance and habit these had undergone in suiting themselves to the rigorous climate, and to see and to study, as far as practicable, the sea-elephants which make it their summer resort. The island, according to Captain Cowper, who, in the Jessie Niccol, has made a number of trips there, is wrongly put down on all the charts, being at its north end 54° 26′ and at its south end 54° 44′ south, and in longitude lying between 159° 5′ and 159° 1′ east. It is about 18 miles long and 5 miles broad. The Professor gives the island a barren character, but tells us indirectly that it has long been a sealing station. It is a solitary island, he says, but it has two outlying rocks—one called the "Bishop and Clerk," 30 miles from the south end of the island, and one called the "Judge and Clerk," 7 miles to the north of the North Head, but gives us no information as to the origin of their names.

As little is known about Macquarie Island, the Professor's short description may be here incorporated, with the idea of diffusing a knowledge of an island which may yet prove of commercial value to this Colony. He describes it as exceedingly hilly, but singularly adds: "The hills, however, are of no great height—not more than 600ft. or 700ft., as I should think. They rise, as a rule, almost directly from the sea, leaving but a narrow interval of shingly beach; while occasional spurs run out from wide open bays, which afford no shelter to vessels. Towards the north end of the west coast there is a greater extent of flat land between the hills and the sea. Between the steeper part of the hillside and the shingle, there is always a more gently-sloping belt of extremely swampy land. And here the tussock grass grows in 'Maori heads' above the soft, treacherous mud. At both ends of the island, however, the land rises in cliffs abruptly from the sea; and the North Head forms a bluff distinct from the rest of the island, and only connected with it by a narrow neck of sand, through which the sea in stormy weather has been known to break. The west coast is, as might be expected, more cut into by the sea than the east, but there are no bays suitable for harbours. At the south-west corner of the island there is, indeed, a beautiful deep bay called Caroline Cove, completely sheltered from every side except the south-west. It is completely open to that quarter, however, and as the prevailing wind blows from the south-west, and therefore straight into the bay, it would rather prove a trap to any vessel that anchored in it. There are still visible on the beach the remains of a vessel which was wrecked in this manner. The sealing vessels always lie some distance off the coast, ready to slip and go to sea at any moment. The oil, in large casks, is floated out to them. The Caroline Cove wreck is not the only vessel that has gone ashore on Macquarie Island, and there are still to be seen the graves of some of the shipwrecked seamen. On the bit of plank which served as headstone for one of them, I was able to decipher the name—John Bilsham—but the date was illegible. The interior of the island shows the rocky tops of the hills blown perfectly bare by the wind, and fissured by the frosts; and in the hollows of the uplands lie a number of little lakes which empty themselves by streams. These either make valleys for themselves down to the sea or tumble down the steep hillsides in miniature cascades. The general appearance of a Macquarie Island landscape is barren in the extreme. There is not a tree or shrub on the island, and what vegetation there is has a great deal of sameness—long stretches of yellowish tussock, with occasional great patches of the bright-green *Stilbocarpa polaris*, or of the peculiar sage-green *Pleurophyllum*. These, with the rich brown mosses near the hill-tops, are all that strike the eye in looking at the island from the sea. This paucity of species is one of the characteristics of the flora of antarctic islands."

Professor Scott's notice of the sea-elephant is as follows:—

"*Morunga elephantina* (Sea Elephant).—This is the largest of the seals, and receives its name of elephant from the curious manner in which it elongates its nose when excited or angry. It is regularly hunted for its blubber, which forms a thick layer underneath the skin. Macquarie Island is the only place near New Zealand where these elephants are found; but they are common on the shores of Kerguelen Land and the neighbouring islands, and occur even as far north as Juan Fernandez. I judged some of the larger males I saw to be over 20ft. long. The females, however, are very much smaller. They are thick in proportion, and are huge, unwieldy creatures.

"The usual colour is a yellowish-brown; some, however, are redder in colour. The young ones are almost black. For about one week after their birth they retain a beautifully soft, furry coat, also black in colour.

"The main peculiarity of these creatures is the mobility of the nose. This, when the animal is asleep or undisturbed, presents no peculiarity. Irritate him, however, or see him naturally excited, and you will soon see the curious change which rage produces in his face. He invariably, however young, rears himself, sometimes at both ends, and opens his mouth to its fullest extent, showing all his teeth, and uttering a peculiar barking roar. At the same time the nose in the adult males undergoes its peculiar change. It is partly by air being blown forcibly into its elastic-sided cavity, and to a certain extent by muscular contraction, puffed out in great sacs above the animal's head. It elongates as well as swells, and hangs down as a trunk for some inches in front of its mouth. None of the plates of the sea-elephants which I have seen repre-present this nasal swelling at all as it is. I was fortunate enough to see two large animals thoroughly angry. I was not able to observe much of this animal's habits during the few days I spent on this island. I usually saw them lying asleep in groups on the shingle or in the long tussocks near the beach. I sometimes saw them gambolling in the shallow water among the kelp, and occasionally I noticed them fighting in a half-hearted sort of way. The scarred hides and broken tusks of the old males, however, show that they sometimes have savage encounters. In fighting, they rear themselves against each other and try to seize their opponent with their large canines. These are the only teeth they could use for such a purpose, as the others barely pierce the gum. They are never to be seen feeding on the island, and during the breeding season live on their own fat. Little or nothing in the way of food is ever found in their stomachs, but these and the intestines are infested with parasitic worms.

"The island is never entirely deserted by the sea-elephants, but by far the greater number are to be found after October, when they come up to calve. The period of gestation is said to be eleven months. The cows, I was told by the sealers, suckle their young for three weeks, and then wean them by deserting them for a time. Whether this be the case or not I cannot say, but I certainly often saw very young animals lying on the beach apart from the adults.

"The sealers say that a bull is not worth killing for its blubber until it is three years old. The tongue of this animal when well cooked is excellent eating."

Mr. A. W. Scott says: "The aged male acquires a length of 30ft. and a girth of 20ft., doubling the dimensions of the great elephant itself."

When taken young they are easily tamed, and become very affectionate. One petted by an English sailor became so attached to his master from kind treatment for a few months that it would come at his call, allow him to mount upon his back, and put his hands into his mouth.

It is said by another authority that when the females produce their young the males form a line between them and the sea to prevent the desertion of their charge, even for the shortest space of time. This period of nursing and imprisonment lasts for seven or eight weeks, during which time the females are debarred from food, and become extremely emaciated.

An adult male will yield some 70 gallons of oil, and which in quality, Mr. A. W. Scott says, is limpid, free from smell, never becoming rancid, and in burning smokeless. It is greatly adapted for softening wool, and for other purposes in the manufacture of cloth. The hide is used for carriage and horse harness.

The food of the sea-elephant is said to consist principally of cuttle-fish and seaweed. The curious can find some further details about the sea-elephant in M. Peron's voyage to Australia.

As the Government purpose leasing the right to seal within the Colony of New Zealand—which extends within the area comprised between the 162° east longitude and 173° west longitude, and between 33° and 53° of south latitude—it seemed expedient not only to describe the species of seals found within its limits, but to furnish some information as to the extent of the sealing industry in the past, as an index of what it may again assume under careful and wise conservation.

WHALES

The recent increase in the price of whaling products has been so marked, and gives indication of being so permanent, that, coupled with the remembrance of the large proportions the whaling trade of New Zealand assumed some fifty years since, it seemed as necessary to give some details about past whaling as about past sealing. That the whaling trade had taken a new departure was evident to those who watched the markets some three years since; the only matter for doubt being how long the improvement would last.

The expansion in price was in this manner illustrated in the *Whalemen's Shipping List* (published at New Bedford) on the 14th January, 1884. The *Whalemen's Shipping List*, it may be said, is the main organ of the whaling trade. "The following voyage by one of our whalers was made up after the cargo was sold, March 11th, 1833, nearly fifty-one years ago: 9,800 gallons sperm-oil, at 70 cents; 59,567 gallons of whale-oil, at 20 cents; 14,484lb. of whalebone, at 11½ cents per lb., amounting to 20,439 dollars. To-day the same cargo would bring 99,517 dollars."

Let us take a retrospective view of what may be called the old New Zealand whaling trade.

The first whaling station in New Zealand was established in 1827, at Preservation Inlet, near the south end of the Middle Island, and in a few years, we are told, there were twelve stations between that place and Banks Peninsula. Mr. Charles Enderby, who was examined before a committee of the House of Commons, prior to the founding of this Colony, stated that whaling ships visited New Zealand as early as 1794; and that about the beginning of this century the New Zealand coast seems to have been a well-recognised whaling-ground. Our first-quoted authority is, however, careful to state that whale ships came to New Zealand about the beginning of the century, when it was ascertained that the coasts abounded in seals, and that numerous whales visited Cook Strait, Queen Charlotte Sound, Dusky Bay, Banks Peninsula, Poverty Bay, Hawke Bay, the Bay of Plenty, the Bay of Islands, and a large number of other places. Mr. Mackay says that the intercourse with the Natives was marked by great cruelty and injustice on the one part, great treachery and dishonesty on the other, and a revolting bloodthirstiness and spirit of revenge on

both sides. Excepting in the sole instance of an English sailor, the only survivor of a shipwrecked crew, who lived some years among the Natives, · · · there is no record of other white men having lived on shore between the years 1793 and 1814."

Wakefield states that whaling stations were laid out about 1827 in Queen Charlotte Sound, Kapiti, and Cloudy Bay. It was in this year also that, having purchased large supplies of guns and ammunition from whalers in Cook Strait, that Te Rauparaha crossed over to the Middle Island. Whalers were at the Bay of Islands when visited by Breton in 1831. In 1833, Messrs. G. and E. Weller, merchants in Sydney, founded a whaling establishment at Otago, which was for a short time the most successful and important of any on the coasts. In 1834 the whales caught yielded 310 tuns of oil, beside bone, and for several years there were on this station from seventy-five to eighty Europeans constantly employed. In 1840 the oil fell off to 14 tuns, and the fishery was abandoned. Waikouaiti was a whaling station in 1837, and came into the possession of the late Mr. John Jones in 1838, when the catch was forty-one whales, yielding 145 tuns of oil and one and a-half tons of bone, valued in New Zealand at £1,500, or £4,500 in the London market. In 1838 two parties established themselves at the New River, Southland, and fished with success. The Lynx, a ship of 500 tons, came into the river for oil, and on going out with a full cargo ran ashore and got lost. The most westerly whaling station on the southern coast at this time, it appears, was Aparima.

The valuable whaling statistics preserved and compiled by Dr. Shortland may here appropriately be inserted.

STATISTICS OF WHALING STATIONS SOUTH OF BANKS PENINSULA.

Names of Places.	Owners or Superintendents.	Year.	Boats Employed	Fish Caught.	Oil in Tuns.
Rakituma, or Preservation	Williams	1829	3	—	120
		1830	4	—	143
		1831	4	—	152
		1832	4	—	115
		1833	4	—	156
	J. Jones and W. Palmer	1834	3	—	114
		1835	4	46	176
		1836	5	45	170

STATISTICS OF WHALING STATIONS—*Continued.*

Names of Places.	Owners or Superintendents.	Year.	Boats Employed	Fish Caught.	Oil in Tuns.
Aparima, or Jacob's River	J. Jones	1839	—	—	80
		1840	—	—	101
		1841	—	—	60[1]
		1842	—	—	40
		1843	—	—	50
Omaui, or New River	Joss and Williams.. 2nd Fishery (Brown and Carter	1838[2]	—	—	120
Awarua, or Bluff Harbour	J. Jones	1838	2	—	53[3]
		1839	2	—	80
		1840	2	—	65
		1841	2	—	60
		1842	3	—	67
		1843	5	—	60
Mataura, or Tois-Tois	Chasland, and James Brown	1835	—	11[4]	—
		1836	—	—	30
Waikawa ..	Groce (Sydney) ..	1838	—	—	50
	J. Jones	1839	—	—	40
		1840	—	—	3½
Tautuku ..	William Palmer ..	1839	—	11	74
		1840	—	11	72
		1841	—	11	53
		1842	—	9	36
		1843	—	2	10
Matau, or Molyneux	William Palmer ..	1838	—	5	25

1. Two sperm-whales also were caught this year.
2. These two fisheries were abandoned after this season, the Lynx, a vessel of 500 tons, with a full cargo of oil, having been wrecked in going out of the harbour.
3. Ten tuns may be added to each year's produce for tonguers' oil.
4. Eleven whales were caught in seventeen days. The oil was lost, there being no casks at the station.

STATISTICS OF WHALING STATIONS—*Continued.*

Names of Places.	Owners or Superintendents.	Year.	Boats Employed	Fish Caught.	Oil in Tuns.
Taieri	Weller	1839	—	—	70
		1840	—	3	15
		1841	—	2	8
Otakou	G. and E. Weller ..	1833[1]	4	Calculated from the average $5\frac{1}{2}$ tuns of oil to a whale.	128
		1834	8		310[2]
		1835[3]	12		260
		1836	12		210
Otakou and Purakaunui		1837	12		272
		1838	12		213
		1839	12		65[4]
Otakou	J. Hoare	1840	2		14[4]
		1841	2		10[4]
Waikouaiti ..	Wright and Long ..	1837	—	—	—
	J. Jones	1838	—	41	145
		1839	—	—	125
		1840	—	—	104
		1841	—	9	40
		1842	—	4	11
	J. Jones and others	1843	—	5	23
Onekakara, near Moeraki	J. Hughes	1837	—	23	88
		1838	—	27	119
		1839	—	25	108
		1840	—	19	55
		1841	—	9	54
		1842	—	2	9
		1843	—	1	$8\frac{1}{2}$

1. An equal number of Natives and Europeans were employed in the first four years; latterly, only half as many of the former.
2. The American ship Columbus also caught 200 tuns of oil in the harbour this year.
3. To this quantity must be added the oil produced by the vessels, four or five in number, that fished in the harbour this year.
4. During these three years nearly an equal quantity of oil was taken by the shipping which entered the harbour as that by the shore parties. The number of Europeans employed on the establishment from 1838 to 1840, inclusive, averaged seventy-five to eighty men. During the years 1841, 1842, 1843, nineteen sail of vessels entered the harbour, principally French.

An analysis of these returns will show that the southern period of whaling prosperity for shore parties was from the years 1833 to 1841 inclusive, the gross annual yield of these stations to the shore parties being as follows: 1833, 243 tuns of oil; 1834, 466; 1835, 374; 1836, 416; 1837, 530; 1838, 725; 1839, 642; 1840, 430; 1841, 285. There may, perhaps, be similar records of the take of the northern whaling stations, but the compiler has not been fortunate enough to meet with them in his somewhat hurried investigation.

How large a factor New Zealand was, before 1840, in the Southern British whaling trade—which at that period had its head-quarters in Sydney—may in some measure be gauged by the following data, to be found in one of the appendices to the United States Exploring Expedition, commanded by Lieutenant Wilkes:—

RETURN OF OIL, ETC., EXPORTED FROM NEW SOUTH WALES, FROM THE YEARS 1830 TO 1840 INCLUSIVE.

Year.	Sperm Whale.	Black Whale.	Whalebone.	Sealskins.	Value.
	Tuns.	Tuns.	Tons. cwt.	No.	£.
1830	983	98	9 16	9,720	59,471
1831	1,571	505	28 5	4,424	95,569
1832	2,491	695	43 6	1,415	147,409
1833	3,048	418	—	1,890	146,855
1834	2,760	975	43 15	890	157,354
1835	2,898	1,159	112 0	641	180,349
1836	1,682	1,149	79 0	386	140,220
1837	2,559	1,565	77 8	107	183,122
1838	1,891	3,055	174 0	3 cases	197,644
1839	1,578	1,229	134 14	7 cases	172,315
1840	1,854	4,297	250 0	474	224,144

According to Lang, "The French whalers were employed chiefly, though not exclusively, in the pursuit of the black-whale. · · · The Colony exported to Sydney," he wrote, "in one year not less than 71 tons of whalebone, an article which generally sells at £145 per ton in the London market. · · · Now, as each whale affords about 5cwt. of bone, there must have been not fewer than 284 whales killed by the parties belonging to the mercantile house to which I refer. · · · The whales caught on the New Zealand ground yield one-third more oil than an animal of its size and species caught in any other part of the world."

STAT

Names of Pla

Taieri ..

Otak ..

O

...ay Bay there are several large whaling ...that large sheet of water is visited by ...black-whale."

...enerally established, Dr. Shortland tells ...lands, close to which there was deep water, ... could be had of the offing and of any ...ance to sport there. It required, he con... money to equip a whaling station. A pair ...ected in order to raise the immense carcasses ...hey could be more conveniently and expedi... ...as also necessary to build "trypots," in which ...ied. Three or four well-built and well-found ... outfit. All these establishments seem to have ... the same system. What that system was like ...appily tells us: Some merchant at Sydney made ... outlay. The men employed in the active part ... paid by receiving a certain percentage of the oil ... following was the ordinary scale of payment: The ...'s share was 1-18th; a headsman's, 1-28th; a boat...th; a cooper's or carpenter's, 1-70th, or monthly ...man's, 1-100th. The remainder was the share of ... at whose expense the station had been fitted out, ... the advantage of taking the oil at his own valuation, ... very much in his favour, as is evident from comparing ... which it was usually bought in New Zealand with its ...e London market:—

... 1843.	In New Zealand.	In London.
... of black oil, ... tun	£8 to £12, paid in rum, goods, and part cash	£30 cash.
...e of bone, per ...on	£50 to £56, paid in rum, goods, and part cash	£160 and upwards cash.

During the whaling season the store was allowed to remain empty, but as soon as it drew to a close a ship came with a supply of spirits and goods suited to the tastes of the place, and received a return freight of oil. Each man had then a credit to the amount of his share, if he had not, as was generally the case, an old debt to wipe out. Forthwith all hands gave themselves up to drink the infamous rum, or arrack, with which they were supplied, and continued to do so as long as this credit lasted. Then followed several months of idleness and misery, during which they were badly fed, and frequently became a prey to

delirium tremens, or "the horrors," as they aptly call that disease. Sometimes, having exhausted all their rum and eatables, they would embark in a body and visit the nearest station, where, if they found their comrades in a better plight than themselves, they would remain till they had eaten and drank up all they had; and then, with increased numbers, make an inroad on the next station, and so on till all within reach had become reduced to the same state of poverty. The merchants who fitted out these stations encouraged this mode of life as much as possible in order to bring into their purse a larger gain; for, instead of paying in cash for the oil, they paid in property, which was retailed at a price much above the cost in Sydney. Thus the established price of 1lb. weight of tobacco was 3s. 6d., which tobacco had been purchased, very likely, but a short time before from an American whaler at 7d. per lb., and, of course, no duty had been paid for it. The men being generally in debt, and, having no money, were in a manner bound to the place, for there they could always obtain on credit, from time to time, a supply of necessaries just sufficient to keep them till the commencement of the next season. Indeed, it would have been difficult for any of them to leave the country, for no other vessels ever came near except those of their employers, in which, if they had wished, they could not have obtained a passage. Not even a letter from them was suffered to reach their friends at a distance, all alike being destroyed at sea, as there existed a great jealousy lest any information relative to the fisheries should be made public in Sydney. The different whaling parties, in 1840, on both shores of Cook Strait, near Banks Peninsula, and still further south, were reckoned to produce 1,200 tuns of oil annually, and were composed of some 500 white men, beside Natives. As many as thirty-nine whale-ships were seen in Cloudy Bay at one time. In 1843, when whales had become comparatively scarce, twenty whalers at one time were seen in Port Chalmers.

Dieffenbach in his report says: "In Terawhiti there are three whaling establishments. The proprietors have a number of boats in their service, manned by white people and Natives. Sometimes the minor settlers have boats of their own, and sell their oil to the former. · · · From Terawhiti fifteen to twenty boats go out every morning. The boat-steerer is a European, and the crew Natives. In Cloudy Bay there are three similar establishments. From May to October the whales visit the bays to bring forth their young."

The bulk of the whales killed by the shore parties were chiefly cows and their calves. Calves a year or so old were called "scrags," and yielded about 4 tuns of oil. From analysis of Dr. Shortland's statistics it will be seen that a large proportion of the captures must have been calves. One of Dieffenbach's earliest notes is: "We passed several huge carcasses of whales

sunk under water." The black-whale was the kind generally pursued, giving as they did more oil than either the finback or the humpback. The black-whale was also less difficult to capture; the calf, inexperienced and slow, was easily dealt with, and its baleen, moreover, was of a superior quality. The sperm-whale keeps in deep water, as do the males of the black species. The sperm-whale is cosmopolitan, it being now conceded that there is but one species in all seas.

"A black-whale, 60ft. in length, in 1840," Dieffenbach says, "was regarded as of an unusually large size. The whaling season in this country is from May to October, or was when the cows came to the coasts for the purpose of calving. It was then the shore-whalers found their occupation." The same writer, who had better opportunities of obtaining information about this branch of the cetacea than we have, says: "The migrations of the whale are the most interesting part of their history. They arrive at the coasts of New Zealand in the beginning of May, from the northward, go through Cook Strait, keeping along the coasts of the Northern Island, and pass between the latter and Entry Island. This is borne out by the fact that they are never seen on the opposite coast, nor do they enter the northern entrance of Queen Charlotte Sound. From Entry Island they sweep into Cloudy Bay, and at the end of October they go either to the eastward or return to the northward. In the beginning of the season the chase is said to be most successful in Cook Strait and Terawhiti; in the three latter months in Port Underwood. From the month of June they begin to show themselves near the Chatham Islands, where their number increases with the termination of the season. During the remaining six months of the year the ships cruising in the whaling ground fall in with many whales. This whaling ground extends from the Chatham Islands to the eastward of the Northern Island of New Zealand, and from thence to Norfolk Island." From the whaling stations at Terawhiti, Cloudy Bay, Porirua, Banks Peninsula, Entry Island, Evan Island, Taranaki, and Table Cape, the same writer says, the number of whales annually captured was about 120; and as each whale averaged about 6 tuns, the annual yield alone from that part of New Zealand would be about 720 tuns.

During the year 1836 no less than 186 whaling vessels visited the Bay of Islands, of which number ninety-eight had American owners. Fifty vessels, entering the bay during the six months ended December 31st of the same year, had on board 36,700 barrels of oil. Thompson says that in that year no less than thirty-six whale-ships were at anchor in the bay at one time. In 1838 the arrivals of whalers were of the following nationalities: American, 36; English, 23; French, 21; Bremen, 1; New South Wales, 24; from the coast of New Zealand, 6.

The American whaling fleet actively employed on the coast of New Zealand in 1840, Wilkes computed at 100 sail.

In 1843 Brodie says the oil caught on the New Zealand coast amounted to 1,290 tuns, which, at £15 a tun, was equivalent to £20,350. It employed eighty-five boats and some 730 men. The yield of whalebone was stated at 75 tons.

Whaling stations varied greatly in size. The one at Te Awitu, in Queen Charlotte Sound, contained in 1839 thirty houses. Aparima in 1843 had a population of twenty white men, while in 1850 no less than 107 European whalers were resident in Stewart Island and Foveaux Strait.

The whaling stations dependent on Wellington in the season of 1844 were as follows: North Island: Mana, 2 boats; Kapiti, 7; Hawke Bay, 11; Palliser Bay, 3; Taranaki, 2; Terawhiti, 2. Middle Island: Port Underwood, 7; Kaikoura, 8; Port Cooper, 4; Banks Peninsula, 9; Waikouaiti, 2; and stations further south, 11. These sixty-eight boats employed in their own management and that of the small craft attending on them about 650 hands. In the season of 1844 they obtained 1,215 tuns of oil and 49 tons of whalebone, worth together in the London market some £50,000.

In 1845 Kapiti was considerably reduced as a whaling station, though then the largest in New Zealand. There were then only about fifty or sixty Europeans employed, though a few years previously Power said there were seven establishments on the island, all larger than the one remaining. At that time there were four European women on the island.

From the whaling statistics published in the Imperial Parliamentary Papers of 1838 it seems evident that the whaling trade at the Bay of Islands mainly consisted in the calling of vessels engaged in the sperm-oil fishery. Of the fifty vessels entering the bay, alluded to in a previous paragraph, no less than thirty-six were thus employed, the remainder being engaged—with one exception, which had 1,500 barrels of black oil on board—in the conveyance of merchandise. Of these thirty-six vessels engaged in the sperm-oil business, no less than thirteen were from America, and their catch would not appear in the returns, obtained by Lieutenant Wilkes, from the Customhouse authorities in Sydney, and which are to be found on a previous page. It is only by gathering and grouping such facts as these tables show that aught like even an incomplete outline can be seen of the whaling trade as a whole in these waters in the decade between the years 1830 and 1840. The sperm-whalers used the Bay of Islands as their port of call, while the black oil whalers were generally found about Cook Strait and further south. So at least the table above referred to would indicate.

The following details are gleaned from official records :—

TABLE OF EXPORTS OF WHALE FISHERIES OF NEW ZEALAND.

Date.	Whalebone. Cwt.	Whale Oil. Gals.	Sperm Oil. Gals.	Whale-bone Value.	Whale Oil. Value.	Sperm Oil. Value.
				£	£	£
1841	—	106,848	1,134	—	7,152	230
1842	—	98,790	10,237	—	5,838	1,984
1843	—	167,958 and 256 Casks	4,032 and 38 Casks	—	16,168	1,686
1844	—	252,504	10,584	—	18,292	2,414
1847	—	151,704	15,254	—	8,711	3,951
1848	—	53,676	6,552	—	3,251	1,401
1849	—	13,230	25,396	—	918	5,184
1850	—	13,230	5,964	—	1,276	1,091
1852	—	13,104	45,360	—	981	9,080
1853	96	51,269	50,761	574	8,096	14,180
1854	34	14,375	33,112	118	2,910	8,070
1855	69	25,472	9,424	421	5,566	3,181
1856	68½	37,238	9,828	500	7,194	3,320
1857	87¾	56,700	4,572	795	10,535	1,407
1858	54½	40,824	7,308	644	6,208	2,011
1859	134¾	66,024	2,799	1,495	11,183	729
1860	94¼	5,840	7,070	1,034	832	1,840
1861	41¼	2,216	9,155	180	326	2,905
1862	46½	7,056	2,445	483	1,028	722
1863	27½	—	—	165	—	—
1864	47½	—	—	375	—	—
1865	—	—	—	73	—	—
1866	30½	—	600	238	—	100
1867	17 pkgs.	—	—	105	—	—
1868	8 pkgs.	—	6,612	100	—	996
1869	46	22,541	7,640	305	3,938	1,676
1870	—	23,454	29,978	—	1,349	6,700
1871	27	3,893	42,920	252	568	11,725
1872	60	13,846	2,982	760	2,970	632
1873	31½	5,787	6,958	112	841	2,057
1874	—	17,326	6,964	—	2,614	2,110
1875	3	20,845	7,775	3	4,100	2,894
1876	10	8,791	18,572	101	875	6,070
1877	143½	17,064	15,047	110	280	4,032
1878	47½	37,801	17,483	371	7,718	4,841
1879	28	3,640	15,707	948	728	3,745
1880	32	2,160	23,969	603	265	5,251
1881	10	1,880	22,686	132	260	5,059
1882	19	8,499	18,194	40	1,050	4,366
1883	79¾	22,463	6,716	822	5,766	1,277
1884	182¼	12,709	25,021	8,511	1,867	5,547
1885	*32*	12,902	49,178	1,451	1,724	7,418

In connection with this table there are several important things to say. The particulars cannot be obtained for the years 1845, 1846, and 1851. The figures for 1841 and 1847 are for the whole Colony, and for 1848 and 1852 for the Province of New Ulster only. Prior to the year 1868 the Customs import and export returns are sadly defective; but in that year the Customs authorities supervised their preparation, and they have been so prepared ever since, every care being taken to secure correct returns as to values and quantities of goods imported and exported. Prior to that date—*i.e.*, 1868—it is feared that little reliance can be placed on the figures in the foregoing table, as it is manifestly impossible that they can represent the full quantity and value of the whaling products exported. Thus from 1841 to 1852, inclusive, the books of the Customhouse at Wellington alone show that no less than sixty-one vessels cleared out laden with "oil and bone," as it was then the custom to call such cargoes. Those vessels were of the tonnage from 50 to 580 tons, but chiefly from 200 to 400 tons each, of which twelve cleared for London, and most of the rest for Sydney and Hobart Town. The object of getting grouped together what figures we possess is, however imperfectly attained, which was to show what a large trade we once possessed, which has now apparently been relegated to strangers or become extinct.

The ambergris of perfumery occasionally is found among our exports. Thus, in 1883, the export was 83½-lb., and in the year following 125½-lb., representing a gross declared value of £6,364. It is obtained, as is now known, from the excreta of the sperm-whales, and is, we are told, probably derived by them from the cuttle-fish, upon which they feed. It is usually found floating on the seas of warm climates.

The following appear to be a list of some of the New Zealand whales; but any attempt to get them into order reminds one of the perplexing habit the Maoris have of changing their names. Thus a youth you may have known very well, say as Tata, may become Rupene as soon as he passes his teens; be called Karaitiana when he takes his first wife; Tareha when he ventures on a second; and something else when he becomes a widower; and so on till he dies, his identity being perplexing in the extreme to those not personally acquainted with him. The above may be an extreme illustration of the Maori habit of change of name, but it is quite emblematic of the large number of names bestowed on whales, as those of almost all kinds have as many *aliases* as a man well known to the police, anxious to escape identification. Thus the species named in the following page have, in most cases, at least half-a-dozen other names given them, from a perpetual recurrence of scientific baptisms, each godfather naming them as his humour dictated.

Family.	Genus.	Species.	Common Name.
Whalebone whales ..	*Neobalæna* ..	*marginata* ..	Western Australian whale
	Eubalæna ..	*australis* ..	Black whale
	Megaptera ..	*lalandii* ..	New Zealand humpback
	Physalus ..	*australis* ..	Finner, or razor-back
	Balænoptera	*Huttoni* ..	Pike-whale
Physeteridæ ..	*Physeter* ..	*marcocephalus*	Sperm-whale
	Kogia ..	*breviceps* ..	
Mesoplodontidæ	*Berardius* ..	*arnuxii* ..	Porpoise-whale
	Mesoplodon ..	*Hectori* ..	
	" ..	*Layardi* ..	
Globiocephalidæ	*Globiocephalus*	*melas* ..	New Zealand black-fish
Hyperoodontidæ	*Ziphius* ..	*cavirostris* ..	

The American record of whaling, before the rise in the price of whalebone, was by no means discouraging; far better, indeed, than is generally imagined. Steamers were being used in the trade; the North Pacific whaling fleet in 1882 consisting of forty vessels, of which four were steamers. The value of the products of the United States whaling industry in 1880 was 2,636,000 dollars; the yield included 37,614 barrels of sperm-oil and 34,626 barrels of whale; 458,400lb. of whalebone, worth 907,000 dollars; and 5,465 dollars' worth of ambergris and walrus ivory.

"The catch of the North Pacific fleet in 1881 included," Hittell says, "354,000lb. of whalebone, worth from 2 dollars 20 cents to 2 dollars 50 cents; 15,000lb. of ivory, worth 60 cents; and 21,000 barrels of oil, worth from 34½ cents to 35 cents a gallon." Wilkes, over forty years ago, wrote: "At a steady price of 35 cents per gallon for whale-oil, voyages would yield a handsome return. Allowing 850,000 dollars for the bone, 280,000 dollars for the oil, and 9,000 dollars for the ivory, there is a total for the season's work – an average of 57,000 dollars for a vessel. Some of them, however, made over 75,000 dollars, while others did not make 30,000 dollars. In 1855, when sperm-oil was worth 1 dollar 75 cents per gallon, whale-oil 70 cents, and bone 45 cents, the average catch of the whalers in the North Pacific was about 38,000 dollars to the ship. The highest average price for the year, of late, of sperm-oil was in 1866, when it rose to 2 dollars 55 cents, and of whale-oil in 1866, when it was 1 dollar 45 cents."

"The whalers sent out from San Francisco," Hittell adds, "vary in value, including all supplies for a voyage, from 15,000 dollars to 40,000 dollars each. As to pay, the common rule is that the owners are to supply the ship, boats, implements, and provisions, and are to receive 60 per cent. of the gross proceeds, leaving 40 per cent. to be divided among the officers and the crew. The captain usually gets about 1-12th, a mate 1-20th, and the ordinary seaman the 1-180th part. A good catch is often worth 45,000 dollars, of which sum the owners would receive 30,000 dollars, the captain 3,750 dollars, each mate 2,250 dollars, and each sailor 250 dollars. The rewards are high for the captains and mates, and the men have 30 dollars a month."

What is whalebone? some will ask; and that with the more curiosity if they have read Bracton or Blackstone, and remember that the whale, being a royal fish when taken in England, is the joint property of the King and Queen; the head belonging to the King, the tail to his consort, the tail of the animal being allotted to the Queen to furnish Her Majesty's wardrobe with whalebone.

Whalebone whales have no teeth; a very small gullet, 1½in. or 2in. in diameter; and live entirely on small marine molluscs and crustaceans. The elder Buckland remarked that the whale, being the largest of warm-blooded animals, and requiring a vast amount of food to support its huge carcass, would have starved to death, if, like other creatures which have heart and lungs, and not gills like fish, it had been sent to sustain itself on land. The whalebone, or baleen as it is called, is the apparatus with which the whale is furnished to capture the crustaceans, etc., on which it feeds.

"When the mouth is open," Jardine says, "it presents a cavity as large as a room, and capable of containing a ship's jolly-boat full of men, being 15ft. or 16ft. long, 10ft. or 12ft. high, and 6ft. or 8ft. wide."

Frank Buckland's description of the baleen, so far as it goes, is the most easily understood, when he says that the plates of the whalebone are placed in the position where teeth are usually found in other animals, in the upper jaw. There are some 380 or more plates on each side of the mouth, which, from the outside, look like the portions of a venetian blind when half opened; inside they cannot be counted, because they appear to be covered with hair. None are found in the lower jaw, which is covered by a hard, firm gum, as polished and smooth as a mahogany table. The hair is in reality nothing more than the actual substance of the baleen unravelled, as it were, like tow from the end of a rope. This hair hangs in thick masses inside the mouth.

Captain David Gray writes: "When the animal opens its mouth to feed, the whalebone springs forwards and downwards, so as to fill the mouth entirely."

When the mouth is closed, and the huge tongue raised in order to decrease the cavity in the mouth, the water streams out through the narrow intervals between the hairy fringe of the whalebone blades, and escapes through the lips, leaving the living prey to be swallowed. In other words, the whalebone forms a huge net with which the whale captures his food. From the ends of the baleen plates, being frayed, it will be understood that the whale can fold or tuck up the flexible extremities when, as sometimes happens, it is longer than the mouth. A writer in a popular *Natural History* says: "The whalebone blade of dense, horny-like material is, in the early stage, composed of a brush of hair-like bodies, which, lengthening, solidify and assume the hard, horny appearance afterwards known in the blade. The gum of the upper jaws has a series of these plates, the one in front of the other, which elongate as growth proceeds, but leave the free extremity with a fringe of separate hairs. Again, the blade towards the gum is embedded in a fleshy substance similar to the roots of our finger nails. It grows continuously from the roots, like the latter, and in many respects corresponds, save that the free end is always fringed. Baleen, therefore, though varying from a few inches to a number of feet long, in fact approximates to a series of, so to say, mouth nail-plates, which *laminæ* have a somewhat transverse position to the cavity of the mouth, and thus their inner split edges and lower free ends cause the mouth to appear as a great hairy archway, shallower in front and deeper behind."

Buckland writes: "Having found out the whereabouts of his food, the whale opens his gigantic mouth and charges at full speed in among them; and I believe he has the power of actually smelling their whereabouts. Drawn into his mouth by the vast current of water created by the charge, like sticks in a mill-tail, they become engulfed in the natural trawl-net of the sea giant, who then composedly shuts his mouth and expels the water through the interstices of the baleen, leaving the clios, and whatever he is lucky enough to catch, high and dry upon the hairy roof of his mouth."

The plates do not appear until after birth. They vary in length and width according to the age and the species of the animal in which they are found. The central blades of the series in the Greenland whale have frequently reached 17ft. and 18ft. in length, whereas, according to Dr. Knox, those brought from the antarctic seas do not, as a rule, exceed 9ft. There are three principal kinds of baleen in the market, and they are generally known as whale fins. The first is the Greenland (or Davis Strait) and North Sea fins; second, the South Sea, or black-fish fins; third, the north-west coast, or American whale fins.

McCulloch, in his dictionary, gives some interesting information on this article of commerce. In the edition of 1882 he says:

"The Dutch have occasionally obtained £700 per ton, and were accustomed to draw annually £100,000 from England for this article. Even in 1763 it brought £500, but soon after fell, and has never risen again to the same value. During the present century the price has varied between £60 and £300, seldom falling to the lowest rate, and rarely exceeding £150. Mr. Scoresby reckoned the price in the five years ending with 1818 at £90; in 1834 it amounted to from £130 to £145; and in 1844 it varied from £280 for southern to £350 for northern. This is for what is called 'size bone,' or such pieces as measure 6ft. or upwards in length. Those below this standard are usually sold at half price. It may appear singular that whalebone should rise while oil has been so decidedly lowered; but the one change, it is obvious, causes the other. Oil being the main product of the fishery, regulates its extent, which, being diminished by the low price, the quantity of whalebone is lessened; while the demand for it continuing as great as before, the value consequently rises. It is, however, probable that the high price of bone may in some degree tend to revive the fishery. In 1867 whale fins alone appear in the list of imports, and of these 137 tons, of the value of £51,286, came into the United Kingdom, chiefly from the northern parts of the United States, the price being per ton from £335 to £440."

How true the forecast was as to a rise in price occurring, soon became evident. In the *Whalemen's Shipping List*, published at New Bedford, on January 15th, 1884, in a review of the whale fishery for 1883, it is stated that whalebone opened the year at 2 dollars per lb. for Arctic, and, with a few variations, steadily advanced, until, at the close of the year, it sold at 4 dollars 75 cents per lb. Later London quotations here follow :—

Per ton.	1886.	1885.
Greenland ..	£1,100 to £1,200 ..	£1,500 to £1,600
Arctic ..	1,100 to 1,200 ..	1,500 to 1,600
Southern ..	550 to 750 ..	750 to 800
Finners ..	20 to 50 ..	20 to 50

Mr. Stephenson, from the Bay of Islands, writes me that "Whalebone has realized for the last three years about 3·00 dollars per lb., the market being ruled according to the catch of whalebone in the Arctic Ocean. I have known whalebone to reach 4·72 dollars per lb.—that is, when the Arctic whalers have been unsuccessful. The quantity passed through my hands for transhipment this last year amounted to 10,600lbs., secured by the few whale-ships visiting this port. This was obtained to the eastward of the Chatham Islands. The bone alluded to is what is called right whalebone, and is taken from what is called the right whale." In the matter of sperm oil, with all its competitors, only two years since, Captain Fisher, of the Alaska, told Consul Griffin

that, at the end of his previous voyage, he had carried into New Bedford the most valuable cargo of sperm oil ever taken into the port, which the Consul describes as the largest for whaling vessels in the world.

Chambers says whalebone requires some preparation before being fit for use. This, however, is very simple. It is first turned—that is, all the hairs are removed from the point and edges of each blade, and generally the surface of each flat side is scraped. The blades are then boiled in water for several hours, until they become soft enough to be easily cut with a common knife. They are chiefly used in thin stripes. Generally the boiling is combined with a dyeing process to make the whalebone perfectly black, which is preferred to the not agreeable natural colour. The quantity annually imported into Britain rarely exceeds 150 tons.

The black-whale, or tohora of the Maoris (*Eubalæna australis*), is the largest and best known of all the whales on the New Zealand coast, reaching a length of 60ft. Its huge bones may be seen strewn on the beach in great profusion at any of the whaling stations, but generally in a bad state of preservation. The females visit the bays and inlets round the coast to calve during the winter months, from May to August, where they are captured by the shore whalers. The males are seldom caught, as they rarely approach the land, and are more shy and wild than the females. From October to May the black-whales are only captured by cruisers on the whaling ground, which extends from the Chatham Islands to Norfolk Island. The American whalers make ports of call at Tonga and Haapai, where they remain until the season sets in. The whalers only recognise one kind of black-whale, which is common throughout all southern seas, and there is no difference in habits, food, or distribution in latitude observable among them.

Dr. Crowther, of Tasmania, supplied Mr. Scott with the following details: "It is essentially a cold-water animal, and has an almost unlimited geographical range, following the polar current almost to the edge of the tropics. So abundant were they (in years past) that 100 were killed by the shore fishermen at the Schouten Islands in four weeks. Each fish would yield 8 tuns of oil and 7cwt. of whalebone."

"The quantity of oil," Polack says. "does not depend on the length of a whale. A right whale of 60ft. may give ninety barrels of oil, or ten imperial tuns; the tongue will render six barrels of an inferior quality, and the under lips (a mass of blubber) will give four barrels. In Tasmania, as in New Zealand. the whalers may be said to have almost felled the tree to obtain the fruit."

That there is no exaggeration in this assertion is evident from the report of the Whaling Fisheries of New Zealand, to be found in the *Proceedings of the New Zealand Institute*, vol. iii.,

where we are told: "One informant states that he has known, for many years in succession, as many as 300 sail of America, besides many German, French, and Colonial vessels, fishing on these coasts. They would commence the bay-whaling in all the principal harbours of the Middle Island, from Cloudy Bay to Preservation Inlet, and would afterwards repair for the off-shore whaling to the banks between New Zealand and the Chatham Islands. Many of them would sink and lose more whales than they procured; on an average, he would consider that each ship lost about fifty whales per season. One, Captain Perkins, stated the he had sunk and lost about seventy in the year 1838. He had known many to lose ten or twelve a day. Another says that far more whales were lost than taken. A Captain Fisher said that he had killed over 300 in one season and secured but 100. . . . When the cows, accompanied by their calves, left for the deep water . . . this wholesale destruction was continued by the off-shore whalers."

As early as 1832 the results of this wholesale killing was foreseen in Great Britain, as Mr. Hay, in April of that year, said, before the Royal Geographical Society: "With regard to the whaling establishments in New Zealand, it may be observed that, as they are of use only about four months in the year, they are not likely to become permanent unless combined with some other pursuit for the summer season; and, from the destructive nature of the fishery (the females being killed at the time of calving), the trade cannot last many years, but, like the sealing, will eventually fail from extermination, or from the desertion of the land by the harassed animals."

And here before aught else is said, the "spouting" or "blowing" of whales, as it is called, may as well be cleared up. A writer in the *Fisheries Literature* says: "It is one of the articles of the common creed respecting whales that they take in water by the mouth and eject it from the spiracle or blow-hole." But the fable, like many others, has to go. Mr. Bell says: "The appearance which gave rise to the idea is caused by the moisture with which the expelled breath is supercharged, which condenses at once in the cold outer air, and forms a cloud or column of white vapour. It is possible," he says, "indeed, that, if the animal begins to 'blow' before its head is actually at the surface, the force of the rushing air may drive up some little spray with it; but this is quite different from the notion that water is really expelled from the nasal passages."

Mr. Beale's evidence, who, as surgeon on board the Kent and Sarah Elizabeth, South Sea whalers, passed several seasons among sperm-whales, may be taken as a type of that of many others. He says: "I can truly say, when I find myself in opposition to

these old and received notions, that, out of the thousands of sperm-whales which I have seen during my wanderings in the South and North Pacific Oceans, I have never observed one of them to eject a column of water from the nostril. I have seen them at a distance, and I have been within a few yards of several hundreds of them, and I never saw water pass from the spout-hole; but the column of thick and dense vapour which is certainly ejected is exceedingly likely to mislead the judgment of the casual observer in these matters; and this column does indeed appear very much like a jet of water when seen at a distance of 1 or 2 miles on a clear day, because of the condensation of the vapour, which takes place the moment it escapes from the nostril, and its consequent opacity, which makes it appear of a white colour, and which is not observed when the whale is close to the spectator. It then appears only like a jet of white steam. The only water in addition is the small quantity that may be lodged in the external fissure of the spout-hole, when the animal raises it above the surface to breath, and which is blown up into the air with the 'spout,' and may probably assist in condensing the vapour of which it is formed. . . . I have also been very close to the *Balæna mysticetus* (the Greenland or right whale) when it has been feeding and breathing, and yet I never saw even that animal differ in the latter respect from the sperm-whale in the nature of the spout. . . . If the weather is fine and clear, and there is a gentle breeze at the time, the spout may be seen from the masthead of a moderate-sized vessel at the distance of 4 or 5 miles."

Mr. Howes says: "Everyone knows the extreme irritation and the horrible feeling of suffocation caused to a human being while eating or drinking by a crumb or a little liquid 'going the wrong way;' that is, being accidentally drawn to the air passages instead of passing to the *æsophagus*. If water were to enter the *bronchi* of a whale it would instantly produce similar discomfort."

Of the *Neobalæna marginata*, or the Western Australian whale, Dr. Gray writes: "This pigmy whale, which is not more than 15ft. or 16ft. long, is a representative in the Southern Ocean of the gigantic right whale of the Greenland seas. It has the most beautiful, the most flexible, most elastic, and the toughest whalebone yet discovered; and, if it were of a larger size, would fetch much higher prices than the whalebone of the Greenland whale, the latter being three or four times the value of the brittle, coarse whalebone of the *Eubalæna* or right whale of the Southern and Pacific Oceans. The trade of the Continental nations being chiefly confined to their colonies, or their merchants obtaining the whalebone that is used in their manufactures second-hand, there are not in the market the varieties of whalebone and finner bones which we have in this country, where the whalebone and finner bone from different localities have each a different value."

At a later date, Dr. Hector says: "I have seen during the past year (1873), several specimens of the baleen of this whale, but never of larger size than that first described as belonging to the type obtained on the island of Kawau. It appears to be found on all parts of the coast, but is described by the whalers as of rare occurrence."

Dr. Hector writes of the New Zealand humpback: "The humpback whales are well known to whalers, but are seldom molested. According to Bennett, they swim about the ocean in small herds, seldom at any great distance from land. They are to be recognised by their having a short, robust form; broad, flat-topped head; a low, broad dorsal fin or lump behind the middle of the body; very long pectoral fins, and the skin of the throat and chest deeply plaited with longitudinal folds." The baleen is short, broad, and triangular, but much longer than the breadth at the base, edged with bristles that are thick and ridged near the tip. (Gray.)

In a small specimen caught at Porirua, the baleen consisted of 300 plates on each side, black and grey in colour, and fringed with coarse white hair. It is said to be the most common whale around our coasts. A specimen caught at the Cape of Good Hope measured, from the top of the lower jaw to the hinder margin of the tail-fin, 34½ft. Another authority says: "An adult averages 50ft. in length. All the species at times seem to delight in endless springing and dashing out of the water. They will yield from twenty to thirty barrels of oil, and a few hundred-weight of an inferior quality of whalebone. The humpback of the Pacific proceeds north in summer, and returns southward on the approaching winter." According to Polack, some specimens have yielded seventy barrels of oil. They obtain their name from a rudimentary dorsal fin in the form of an elevation of the back.

The fourth on the list is the southern finner, or razorback of the whalers, or the southern rorqual. Dr. Hector says the finners are the longest of the whale family, but they are rarely caught; while their great size and activity render them doughty antagonists, and the quantity of oil they yield is small, while their baleen has no commercial value. A specimen was obtained at Port Underwood, in June, 1874, which was 70ft. in length, in which the baleen was said to be coarse, with strong white bristles; light slate-grey, with vertical bands of black, some blades nearly white, yellowish white, and polished towards the angle of the mouth, with a hard enamelled surface. In a subsequent notice of the specimen found at Port Underwood, and mounted in the Colonial Museum, Dr. Hector says: "There are no osteological characters by which it can be distinguished from the great northern rorqual (*Physalus antiquorum*), of which a great deal more is known than of the southern." The northern razorback attains a length of 105ft., and is supposed to be the

whale Aristotle mentions as having in its mouth bristles like those of a hog, and found in the Mediterranean. "The northern razorback is probably," Jardine says, "the most powerful and bulky of created things. Its head is to the entire length as one to four. It differs from the Greenland, or black whale, in its body being longer and more slender; in its form being less cylindrical; in having a dorsal fin; in its skin or blubber being usually much thinner, usually not exceeding 6in.; in its speed being greater, its action quicker and more restless, and its conduct bolder; in its blowing being more violent, and its baleen being much shorter and less valuable." It is now quoted, as before stated, at from £20 to £50 a ton. In Mr. Knox's account of the great rorqual, we read that "314 plates were counted on each side, and, on further examination, it was found that these extended only about 15in., and were succeeded by a vast number of smaller plates, which gradually became less and less, till finally they were converted into bristles; so that, correctly speaking, there were probably not fewer than 4,000 or 5,000 distinct plates of whalebone. The baleen when recent was highly elastic and soft, the fringed edge being as pliable as the hair of the human head, and thus forming a sieve of the most perfect kind." The blubber of an adult does not yield above 8 or 10 tuns of oil; its colour is of a pale bluish-black, or dark bluish-grey, somewhat resembling a sucking Greenland whale. "In Lapland they yield sometimes 15 tuns of oil," Brooke says in his *Lapland*, "and are worth about £150." Chambers says a large rorqual yields about 4,000 gallons. There are some interesting details to be found about them in Scoresby. There are some plates of baleen in the Otago Museum obtained from a whale that came ashore near Coal Point, on the south-east coast of Otago, which Captain Hutton was informed measured 109ft. in length. It may probably have been a Southern finner. "One of these fish," Polack writes, "off the coast of New Zealand, received an iron, but it drew the boat after it with such velocity as to render it useless, the percussion arising from so rapid a motion through the water entirely detaching the planks. Off the Falkland Islands a finback was caught in 1834; there were no less than fifteen boats after the animal, and it was at last caught by running itself aground in shallow water. They visit the coast for similar purposes as the *mysticetus*."

The pike-whale of the south (*Balænoptera Huttoni*), Dr. Hector says, is hardly distinguishable from the northern (*Balænoptera rostrata*). In February, 1880, a specimen was stranded on the Sumner beach in Canterbury, which was examined by Dr. Haast, who says that he has no doubt, after comparing the skeletons, that our New Zealand pike-whale is identical with the northern species. It was 23ft. in length. There were 220 plates of white

baleen on each side, but of a very inconsiderable length. In colour, black above; beneath, reddish-white. This species is well known and active in its habits. It feeds principally on the smaller kinds of fish, and is of solitary nature, few being found together. Its oil is regarded as delicate, and is esteemed, we find in Jardine, by the Icelanders as an article of their *materia medica*. Polack says it rarely acquires a greater length than 40ft., with a circumference of 16ft.

Of the sperm-whale there is no need to make any remark, as its capture is the subject of pictorial representation wherever literature is diffused. Dr. Hector says: "The sperm-whale is ubiquitous in warm seas, and occasionally roams into temperate latitudes. There is now generally admitted to be only one species of sperm-whale common to all seas."

In *The Transactions of the New Zealand Institute*, vol. i., p. 44, we are told: "The black-fish visit the coast in large schools, and occasionally run into shallow bays, where they get stranded and fall a prey to the Natives and settlers. They yield from 30 to 35 gallons of inferior oil, but are not killed without some risk, as they occasion a sickness or vertigo to those who slaughter them, which has sometimes been attended with fatal results."

Mr. James Mackay says that the statement about their causing vertigo to those who kill them—which rests on a misconception of what he himself said—is altogether a mistake, as, in the particular case alluded to, the vertigo arose from the exhaustion consequent on long continuance in the water while engaged in securing a school; and that he on a previous occasion, in the same locality, speared over 180 black-fish, and got for his reward in so doing over £600 in cash—the produce of their oil. Now that Professor Flower has declared that the South Sea black-fish cannot be separated from the Caa'ing whale of the northern seas, the misconception as such is plain. In the Faroe Islands the people live on them, where they are called "grind," and the welfare of the whole community depends on the catch. What blubber is not reduced into oil is consumed as butter, or dried, salted, and eaten—like fat bacon in England and other places.

In January, 1876, a school of black-fish ran ashore in Lyell Bay, and ten skeletons were secured, one large male measuring 19ft. long. The black-fish has the same habits and range as the sperm-whale, frequenting the subtropical seas in large schools, and occasionally, like the great cachelot, extending their migrations to temperate latitudes, and doubling Cape Horn. Scott says: "The museum skulls of this species correspond closely in every characteristic formation and in size with the particulars given of the *Globiocephlus Melas* or Caa'ing whale, and I feel incapable to point out any salient character by which to separate the species."

The other varieties mentioned in the list can hardly, so far as the writer knows, claim a commercial paragraph.

FISHERY LEGISLATION.

In 1867 an Act of the Legislature was passed to make provision for the preservation and propagation of salmon and trout in New Zealand, under the provisions of which numerous Orders in Council have been gazetted from time to time. In 1884, an Amending Act was passed declaring the words "river" or "stream," in the Act of 1867, should "include and apply to any lake or lakes." The Amending Act became necessary, from the destruction of trout in lakes by netting and dynamite, contrary to the intent of the law; the Magistrate whose aid was invoked, ruling that a lake could not be included under the terms "stream" or "river." In 1877 an Act was passed for the protection of fish and fisheries in New Zealand, which included "all fish ordinarily inhabiting the waters of the Colony, whether fresh or salt water." Under this Act, the year following, Orders in Council making certain regulations were gazetted, but on being put to the test were found to be *ultra vires*, and have been considered a dead letter ever since. The same year an Act was passed to prohibit the use of dynamite or other explosives for the purpose of catching or destroying fish in public fisheries—the term "public fishery" meaning "any salt or fresh waters in the Colony, or on the coasts or bays thereof;" also an Act for the protection and preservation of seals, the main purport of which can be gathered from clause 3, which reads as follows:—

"No person shall hunt, catch, or attempt to catch or kill seals between the days hereinafter mentioned (which interval is herein referred to as 'the close season'), that is to say, between the first day of October and the first day of June following, both inclusive; and any person acting in contravention of this section shall forfeit any seal caught by him, and shall in addition thereto incur a penalty not exceeding £50, and a further penalty not exceeding £10 in respect of each seal so caught."

The following Acts relative to and affecting the matters dealt with in this handbook, and the regulations made by Order in Council under their provisions, are reprinted for general information:—

"The Fisheries Conservation Act, 1884."
"The Fisheries Encouragement Act, 1885."

Regulations under "The Fisheries Conservation Act, 1884," contained in Order in Council of the 7th March, 1885, and Order in Council of the 2nd June, 1885.

Regulations under "The Fisheries Encouragement Act, 1885," contained in Order in Council of the 10th November, 1885.

FISHERIES CONSERVATION.

ANALYSIS.

AN Act to provide for the Conservation of Fisheries.—10th November, 1884.

Be it enacted by the General Assembly of New Zealand in Parliament assembled, and by the authority of the same, as follows:—

1. The Short Title of this Act is "The Fisheries Conservation Act, 1884."

2. The several Acts hereunder mentioned, and all Acts passed in amendment thereof respectively, are hereby incorporated with this Act: that is to say—

"The Oyster Fisheries Act, 1866;"
"The Fish Protection Act, 1877;"
"The Fisheries (Dynamite) Act, 1878;"
"The Seals Fisheries Protection Act, 1878."

3. Nothing contained in this Act shall apply to—

(1.) Any person using a landing-net to secure fish caught with a rod and line, nor to any person using hand shrimp net; nor to

(2.) Any person taking fish in water of which he is the owner; nor to

(3.) Any person authorized by such owner to take fish in such water; nor to

(4.) Any person, with the written permission of the Collector or other person duly authorized by the Commissioner of Trade and Customs to grant such permission, taking fish or ova, or oysters, or oyster brood, for the *bonâ fide* purpose of ascertaining and verifying the existence or increase of such fish or oysters, or of removing them to stock other waters; nor to

(5.) Any nets, tackle, or boats used, or fish or oysters taken, by such person; nor to

(6.) Any person who, having unintentionally taken any fish or oysters contrary to the provisions of this Act, shall immediately return the same, with as little injury as possible, to the water.

4. In this Act, if not inconsistent with the context—

"Collector" means a Collector of Customs or other principal officer of Customs, at any port:

"Commissioner" means the Commissioner of Trade and Customs:

"Close season" means the time during which it is declared unlawful to take any species of fish, oysters, or seals; and applies to such season, however the same may be varied or extended:

"Fish" means and includes all fish and mammalia inhabiting the waters of the Colony, whether indigenous or not, their young, or fry, and spawn:

"Oysters" means and includes shore oysters, rock oysters, and mud oysters:

"Prescribed" means prescribed by this Act or by regulations:

"Seals" includes all kinds of seals and their young:

"Take" means and includes "kill," or "catch," or "dredge for," or "raise," or "hunt:"

"This Act" includes the Acts incorporated herewith, and all regulations made thereunder:

"Use" includes "attempt to use" or "assist in the use of:"

"Vessel" includes any ship or vessel of any tonnage, construction, or description:

"Waters" mean any salt, fresh, or brackish waters in the Colony, or on the coasts or bays thereof; includes artificial waters, but does not include waters the property of any private person.

5. The Governor in Council may, from time to time, make, alter, and revoke regulations which shall have force and effect only in any waters or places specified therein—

(1.) Providing for the more effectual protection and improvement of fish, and the management of any waters in which fishing may be carried on;

(2.) In respect of any species of fish, oysters, or seals, respectively—

(*a.*) Prescribing a "close season," or "close seasons," in any year, month, week, or day, as may be most suitable for the whole or any part or parts of the Colony, during which it shall be unlawful for any person to take any fish, oysters, or seals of such species respectively, or in any way to injure or disturb the same; or

(*b.*) Extending or varying any close season so prescribed, or varying any close season so extended; or

(*c.*) Extending any such close season over any term not exceeding three years, and before the expiration of such term, further extending the same;

(3.) Prohibiting the buying, selling, exposing for sale, or having in possession any fish, oyster, or seal, or any skins, oil, or blubber from any seal, in any manner in contravention of this Act;

(4.) Prescribing the minimum size or weight of any fish, oyster, or seal that may be taken;

(5.) Limiting the size, when wet, of the mesh on the square, or in extension from knot to knot, of nets and seines to be used in fishing, or altogether prohibiting the use of nets of any sort;

(6.) Prescribing that all nets containing fish shall be emptied in the water, and prohibiting the dragging or drawing on to the dry land any such net;

(7.) Fixing the time or times during which dredging shall be prohibited, or prohibiting the use of any particular engines, tackle, or apparatus for taking any fish or oysters;

(8.) Reserving from public use any natural oyster-beds, so as to prevent their destruction:

(9.) Setting apart, within any harbour, any bay or bays frequented by fish for the purpose of propagation, and prohibiting the use of nets of any kind in any such bays during such time as shall seem fit; or setting apart any river or other fresh or salt waters for the natural or artificial propagation of fish, oysters, or seals;

(10.) For the protection of young fish or fry, or spawn, at all times, and especially for the preservation and propagation thereof upon its importation into the Colony;

(11.) Prohibiting or restricting from time to time, for any period which the Governor thinks necessary, fishing in any waters, river, or stream in which young fish or spawn is placed or deposited, or at the mouth or entrance of any such waters, river, or stream;

(12.) Prohibiting the casting of sawdust, or any sawmill refuse into any waters, river, or stream.

The Governor may, by such regulations, impose any penalty not exceeding £50, to be recovered in a summary manner before any two or more Justices of the Peace, and also appoint the minimum penalty for the breach of any such regulations; and all such regulations shall be gazetted, and thereupon shall be binding and conclusive upon all persons as if the same had been contained in this Act.

6. Any penalties prescribed by any such regulations as aforesaid for taking, buying, selling, exposing for sale, or having in possession any fish, or oysters, or any seal or seals, during any close season for the same respectively, shall apply to such season, however the same may be varied or extended.

7. All fish, oysters, or seals unlawfully taken, and any skins, oil, or blubber from seals taken as aforesaid, and the baskets or other receptacles thereof, and also all nets, gear, tackle, or other apparatus used in any unlawful fishing, or taking of oysters or seals, whether found on shore or in any vessel or boat, shall be forfeited, and shall be disposed of as the Commissioner may think fit.

8. It shall be the duty of the Collectors of Customs within the Colony to see that the provisions of this Act, and of the several Acts incorporated herewith, are duly carried into effect, and for that purpose they severally shall have and may exercise all the powers granted by this Act and the aforesaid Acts in that behalf.

9. The Commissioner may from time to time appoint such assistants to the Collectors, and such other officers, servants, and other persons as may appear to him to be necessary for the effective administration of this Act; all of whom shall, as well as the Collectors aforesaid, be deemed to be officers appointed under this Act.

10. In respect of any species of fish, oysters, or seals respectively to be affected thereby, all regulations prescribed under this Act shall, on their coming into operation as to any waters or place, supersede therein all enactments at variance with such regulations, in so far as they are so at variance, but not further in any way whatsoever.

11. Nothing in this Act shall allow fish to be taken during close season in any waters except for the purpose of pisciculture.

REGULATIONS UNDER "THE FISHERIES CONSERVATION ACT, 1884."

WHEREAS by "The Fisheries Conservation Act, 1884" (hereinafter termed "the said Act"), it is, among other things, enacted that the Governor in Council may from time to time make, alter, and revoke regulations for the purposes therein mentioned, which said regulations shall have force and effect only in any waters or places specified therein:

And whereas it is expedient to make the regulations hereinafter set forth with respect to oysters, fish, and seals inhabiting the waters of the colony herein described:

Now, therefore, I, William Francis Drummond Jervois, the Governor of the Colony of New Zealand, in exercise of the powers conferred upon me by the said Act, and by and with the advice and consent of the Executive Council of the said Colony, do hereby make the following regulations; and, with the like advice and consent, I do order that these regulations shall have force and effect within the Colony of New Zealand, and in any salt, fresh, or brackish waters in the said Colony, or on the coast or bays thereof, and in any artificial waters within the Colony, not being the property of any private person:—

1. In the interpretation of these regulations the following terms and expressions shall have the meaning hereby assigned to them, unless there be something in the context repugnant thereto, or inconsistent therewith, that is to say:—

"Maori" means any person of the aboriginal native race, and includes any half-caste of that race living as a member of any native tribe or community:

"Tidal waters" mean all parts of the sea, or of a river within the limits of a district constituted under these regulations, within the ebb and flow of the sea at ordinary spring tides:

"Collector" means a Collector of Customs or other principal officer of Customs at any port:

"Commissioner" means the Commissioner of Trade and Customs:

"Close season" means the time during which it is unlawful to take any species of fish, oysters, or seals; and applies to such season, however the same may be varied or extended:

"Fish" means and includes all fish and mammalia inhabiting the waters of the colony, whether indigenous or not, their young, or fry, and spawn:

"Oysters" means and includes shore oysters, rock oysters, and mud oysters:

"Prescribed" means prescribed by the said Act or by regulations:

"Seals" includes all kinds of seals and their young:

"Take" means and includes "kill," or "catch," or "dredge for," or "raise," or "hunt:"

"The said Act" includes "The Fisheries Conservation Act, 1884," the Acts incorporated therewith, and all regulations made thereunder:

"Use" includes "attempt to use" or "assist in the use of:"

"Vessel" includes any ship or vessel of any tonnage, construction, or description:

"Waters" means any salt, fresh, or brackish waters in the Colony, or on the coasts or bays thereof, and includes artificial waters, not being the property of any private person.

2. These regulations shall not extend or apply to any Maori, nor to the taking of fish with rod and line.

3. The months of October, November, December and January in each year are hereby prescribed a close season for shore and mud oysters, and the months of December, January, February, and March in each year a close season for rock oysters. During such close seasons it shall be unlawful for any person to take such oysters: Provided, further, that the close season for rock oysters is hereby extended until the 31st day of March, 1887, in respect of the County of Coromandel and the foreshores adjacent thereto.

4. The months of October, November, December, January, February, March, April, and May in each year are hereby prescribed a close season for seals: Provided, however, that the said close season is hereby extended until the 1st day of June, 1886.

5. No person shall take or burn live oysters for the purpose of converting the shells into lime.

6. No person shall take or dredge for oysters at any time between sunset and sunrise (except an owner upon his own private oyster-bed).

7. No person shall buy, sell, expose for sale, or have in possession any fish, oyster, or seal, or any skins, oil, or blubber of any seal, during the close season for the same; and no person shall buy, sell, expose for sale, or have in possession any fish, oyster, or seal, nor any skin, oil, or blubber of any seal, of a less size or weight than prescribed by these regulations or by any regulations altering or amending the same.

8. No person shall take, buy, sell, expose for sale, or have in possession any fish of any of the species enumerated in the schedule hereto of a less weight or size than that set opposite the name of such fish, and if any such fish of a less weight or size than therein mentioned shall be taken by any person within any fishery affected by these regulations the same shall forthwith be returned alive to the water.

9. No shore or mud oyster shall be taken which can be passed through a metal ring having a clear inside diameter of 1¾in. This regulation shall not apply to oysters which may, with the consent in writing of the Collector or other person appointed under the ninth section of the said Act, be taken for the purpose of being laid down on another bed or in different water.

10. The mesh of every net or seine used for the purpose of taking fish in tidal waters shall measure, diagonally, when prepared for use, wetted and stretched, not less than 2in., unless such net be a *bona fide* gar-fish net or herring net, and used for taking gar-fish or herrings only.

11. The mesh of every gar-fish net shall measure, diagonally, when prepared for use, wetted and stretched, not less than 1in.

12. The mesh of every herring net shall measure, diagonally, when prepared for use, wetted and stretched, not less than 1¼in.

13. The foregoing regulations in regard to the size of the mesh of nets shall not apply to Lake Ellesmere, in the Provincial District of Canterbury, but the mesh of every net used for taking fish in such lake shall measure, diagonally, when prepared for use, wetted and stretched, not less than 4½in.

14. No person shall set any net by the process known as "stalling," whereby a net is staked or set across, or within any bay, inlet, river, or creek, in tidal waters in such a manner that fish enclosed by such net are or may be left stranded at low tide

15. The size of mesh, in every case, shall be ascertained by measuring the length on the diagonal, or between knot and knot of opposite corners, the net being first wetted, and being tanned, barked, or otherwise prepared for use. In case of dispute or doubt a half-pound weight shall be slung or attached to one knot of a mesh, in order to produce a fair strain or extension, and the space between the knots shall be measured forthwith while the mesh remains extended. If the net to be measured is dry, the part to be measured shall be soaked, either in fresh or salt water, for not less than ten minutes, and the mesh so soaked shall then be measured.

16. All nets containing fish shall be emptied in the water, and no such net shall be dragged or drawn on to the dry land.

17. No person shall cast sawdust, or any sawmill refuse, into any waters, rivers, or streams.

18. Any person committing a breach of any of these regulations shall be liable to a penalty of not less than £1 and not exceeding £50.

SCHEDULE.

Description of Fish.	Weight in ounces or pounds avoirdupois.	Length in inches.
Hapuka	Five pounds	
Kahawai	One pound	
Schnapper	One pound	
Tarakihi	Four ounces	
Trumpeter	One pound	
Moki	Eight ounces	
Barracouda	Eight ounces	
Horse-mackerel	Four ounces	
Trevalli	Four ounces	
King-fish	Three pounds	
Warehou	Four ounces	
Mackerel	Eight ounces	
Rock-cod	Four ounces	
Gurnard	Four ounces	
Mullet	Four ounces	
Butter-fish	Four ounces	
Red-cod	Eight ounces	
Flounder	..	Nine inches
Soles	..	Nine inches
Gar-fish	..	Nine inches
Herring	..	Five inches

2. Nothing in these regulations shall be deemed to prevent any Maori from taking oysters or indigenous fish (exclusive of seals and other amphibious mammalia) for consumption by himself and family, and not for sale. Nor shall they extend, or apply, to the taking of indigenous fish with rod and line.

10. The mesh of every net or seine used for the purpose of taking fish in tidal waters shall measure, diagonally, when prepared for use, wetted and stretched, not less than 2in. unless such net be a *bonâ fide* gar-fish net or herring net, and used for taking gar-fish or herrings only.

11. The mesh of every gar-fish net shall measure, diagonally, when prepared for use, wetted and stretched, not less than 1in.

12. The mesh of every herring net shall measure, diagonally, when prepared for use, wetted and stretched, not less than 1¼in.

FORSTER GORING,
Clerk of the Executive Council.

FISHERIES ENCOURAGEMENT.

ANALYSIS.

AN Act to provide for the Establishment of Fishing Towns and Villages, and further to encourage Fisheries in New Zealand, and to promote the Production of Canned and Cured Fish for Export.—1st September, 1885.

Whereas it is expedient to encourage the establishment of fisheries in New Zealand, and the production of canned and cured fish for export, and, further, to provide for the maintenance of fishing populations by setting apart land for their occupation:

Be it therefore enacted by the General Assembly of New Zealand in Parliament assembled, and by the authority of the same, as follows:—

1. The short title of this Act is "The Fisheries Encouragement Act, 1885."

2. In the construction of this Act—

"Fish" means all kinds of fish, including oysters, crayfish, and other shell-fish:

"Cured" means preserving fish by salting, smoking, or drying:

"Foreshore line" means the line laid down as provided by the fourth section of this Act:

"Foreshore" means the land defined by the fourth section of this Act.

3. The Governor may, by Order in Council from time to time, set apart upon the coast-line of New Zealand, or of any bay, harbour, estuary, salt-water creek, or other inlet of the sea, any Crown lands for the purpose of the formation of fishing towns or fishing villages, herein called fishing townships.

4. The Governor shall cause a line, herein called the "foreshore line," to be laid out in every fishing township at such distance inland from the line of low-water mark as he thinks fit, and all the land lying between the said line and the line of low-water mark shall be deemed to be the foreshore for the purposes of this Act.

5. Every Order in Council setting apart any such lands shall provide, amongst other things,—

(1.) For selling, or letting with or without right of purchase, sections of land within any fishing township not being part of the foreshore, but so that no section shall contain more than 10 acres, or have a frontage of more than 100ft. upon the foreshore line;

(2.) For granting licenses to the owner or lessee of any section having frontage on the foreshore line, for the use and occupation of the part of the foreshore adjacent to such section, not being part of any highway or thoroughfare thereon, for the purpose of erecting thereon such wharves, jetties, and other buildings as may be necessary for carrying on the occupation of fishing, curing, and canning fish, and for the import and export of goods connected therewith and otherwise used by the inhabitants of the fishing township, and for determining the conditions and restrictions of such use and occupation under any such license;

(3.) For granting licenses to any person for such purposes and under similar conditions and restrictions, for the use and occupation of any part of the foreshore within a fishing township, not being adjacent to any section so let or sold, and not being part of any highway or thoroughfare;

(4.) For laying out highways and thoroughfares on and through the foreshore, and limiting and defining the right of thoroughfare over the same, and for laying out highways over other parts of the fishing township, and generally for regulating the management, use, and occupation of the lands within the same for the purposes of this Act;

(5.) For granting to the holder of any such license the right to charge tolls for the use of any wharf or jetty, or rent or storage for the use of any building he may have erected under the provisions of such license, and to limit the amount of any such charges.

6. If any person shall use or occupy any part of the foreshore within any fishing township in any other manner than is provided by the license granting the same, or shall violate the conditions and restrictions attached thereto, the Governor may cancel such license, and all right or title accruing thereunder shall absolutely cease.

7. No license granted under this Act shall entitle the holder thereof, either during the term or after the expiry or cancellation thereof, to any compensation in respect of any buildings or other works he may have erected on the land in respect of which such license shall have been granted, unless the right to such compensation shall have been specially set forth in such license.

8. In order to encourage the production and curing of fish for export, the Colonial Treasurer shall, during the next seven years after the passing of this Act, without further appropriation by Parliament, pay out of the Consolidated Fund to any person who shall prepare canned and cured fish for export, and actually export the same from the colony, a bonus or bonuses upon the quantity of canned and cured fish prepared and exported by such person as hereinafter mentioned, that is to say,—

(1.) In respect of the first 200 tons avoirdupois of fish canned, with or without oil, the sum of 1d. per lb., the weight of the cans not to be included in the tonnage upon which such bonus is paid.

(4.) In respect of every ton avoirdupois of fish, canned as aforesaid, beyond the first 200 tons, the sum of ½d. per lb., the weight of the cans not to be included in the tonnage upon which such bonus is paid.

(3.) In respect to cured fish, the bonus to be paid shall be respectively ¼d. and ⅛d. per lb., under similar conditions, as far as the same are applicable to those contained in the last two subsections.

9. The total tonnage upon which the Treasurer may grant bonuses as aforesaid under this Act shall not exceed 6,000 tons.

10. Every person intending to apply for the grant of a bonus shall register a special trade-mark under the laws for the time being in force in New Zealand providing for the registration of trade-marks, such trade-mark to be used for all cured and canned fish to be prepared for export by such person, and shall, within six years after the passing of this Act, give notice to the Treasurer of his intention to export canned and cured fish with a view to applying for a bonus, and shall append to such notice a copy of such trade-mark; and all cases, barrels, or cans containing fish cured and canned for export by any such person shall, before exportation, be marked with the trade-mark so registered by him, and no part of any such bonus shall be payable except in respect of cases, barrels, or cans so marked.

11. The Governor in Council may from time to time make regulations prescribing the form of claim for any such bonus, and the form and nature of the evidence which shall be used and produced by any person or persons claiming the payment of any such bonus, and in relation to any matter affecting the right of such person thereto; and every person claiming any such bonus shall

deliver such claim to the Collector of Customs at the port from which any fish, in respect whereof such claim shall be made, has been exported, together with such evidence as shall be prescribed by such regulations; and it shall be the duty of such Collector of Customs to forward such claim and the evidence in support thereof, together with a report by himself thereon, to the Treasurer, who shall thereupon pay the bonus claimed if satisfied with such evidence, or otherwise act thereon in such manner as he shall think fit and reasonable.

12. Any person who shall wilfully, by means of any false representation, procure, or endeavour to procure, the payment of any such bonus without having duly complied with the provisions of this Act, and of any regulations made thereunder, shall be guilty of a misdemeanour, and on conviction thereof shall be liable to imprisonment for any period not exceeding two years.

13. The Governor may, by Order in Council, from time to time regulate or prohibit the exportation from the Colony of any fish caught or produced in the waters of the Colony. Any such order may be made in respect of any particular kind of fish as defined by this Act, or may be made in respect of all fish so defined.

If in breach of such order any fish be exported, or found on board of any ship, or be brought to any place to be shipped for exportation from the Colony, they shall be forfeited; and any person offending against the provisions of this section, or any Order in Council issued in pursuance thereof, shall, for every such offence, be liable to a penalty not exceeding £100, to be recovered in a summary way.

All fish declared liable to forfeiture by this Act may be seized by any officer of Customs in the manner prescribed by "The Customs Laws Consolidation Act, 1882," and may be sold or otherwise disposed of as by that Act is provided in the case of the seizure of uncustomed or prohibited goods.

14. All Orders in Council and regulations from time to time made under the provisions of this Act shall be published in the *Gazette*, and a copy of the *Gazette* containing any such Order in Council or regulations shall be absolute evidence thereof.

BONUS FOR CANNED AND CURED FISH FOR EXPORT.

Treasury Department.
Wellington, 10th November, 1885.

IT is hereby notified that bonuses under "The Fisheries Encouragement Act, 1885," as set forth in the following sections (Nos. 8, 9, and 10) of that Act, will be paid subject to the conditions named therein, and in the regulations contained in the Order in Council of even date herewith.

JULIUS VOGEL.

See Reprint of Act at pp. 285-288.

REGULATIONS UNDER SECTION 11 OF "THE FISHERIES ENCOURAGEMENT ACT, 1885."

WHEREAS by "The Fisheries Encouragement Act, 1885," it is, among other things, enacted that the Governor in Council may from time to time make regulations prescribing the form of claim for any bonus granted under the said Act, and the form and nature of the evidence which shall be used and produced by any person or persons claiming the payment of any such bonus, and in relation to any matter affecting the right of such person thereto:

Now, therefore, His Excellency the Governor of New Zealand, in pursuance of the authority conferred by the said Act, and with the advice and consent of the Executive Council of the said Colony, doth hereby make the following regulations, that is to say,—

1. Claims for any of the bonuses specified in the eighth section of "The Fisheries Encouragement Act, 1885," must be made on Treasury forms known as "Abstract of Contingencies," on which must be specified the number and date of the export entry passed at the Customhouse for each shipment of canned or cured fish in respect of which a bonus is claimed, the name of the ship on which the same was exported, and the net weight of each shipment. Payments will be made on quantities of 1 ton and upwards from time to time as exported. To the particulars here stated a declaration in the following form shall be appended:—

I, , of , do hereby solemnly and sincerely declare that the canned [*or* cured] fish specified above were prepared for export by me at

(Person claiming bonus.)

Declared before me at the Customhouse, this day of , 188 —Collector of Customs.

2. Claims for bonuses shall be supported by Customs landing certificates for each shipment from the ports or places to which the canned or cured fish was exported, or by such evidence in lieu thereof as may be satisfactory to the Colonial Treasurer.

3. Canned or cured fish in respect of which a bonus is to be claimed shall be shipped under the supervision of the officers of Customs at the port of shipment, who shall open and examine such number of packages in every shipment as may be necessary for the purpose of ascertaining that such fish is at the time of shipment in good order and in sound marketable condition, and the proper officer of Customs shall certify, on the back of the export entry, as to the order and condition and the net weight of the fish, and also that the packages containing such fish have on them the registered trade mark of the person by whom the said fish has been prepared and exported.

4. The Collector of Customs at the port of shipment shall be satisfied that the conditions of the last-preceding section are strictly complied with, and shall certify to the due shipment and exportation of all canned or cured fish which may be shipped by any person intending to apply for a bonus in respect of the same.

FOSTER GORING,
Clerk of the Executive Council.

REPORT BY CROWN LANDS RANGER ON LANDS SELECTED AS SITES FOR FISHING STATIONS IN COUNTY OF SOUNDS.

General.

IN carrying out the work entrusted to me of selecting land for reservation with a view to the fishing industry, it is only in the Pelorus Sound I was able to make the selections on anything like a definite plan. In Queen Charlotte Sound and Port Underwood so much of the land has passed into private hands that it is impossible to predict where the central or curing stations will be established, as this, in a great measure, must now depend on the terms persons desirous of embarking in the industry can make with the owners of the ground. In the Pelorus Sound, finding blocks of land well situated and in every way adapted for the central stations, and having determined on these sites, my next care was to select other and smaller blocks to serve as outposts, or places of refuge or shelter, from the violent and sudden changes of wind which characterise the climate of the district. Although generally throughout the County of Sounds the land for one chain deep above high-water mark has been reserved, where the land at the rear has been purchased, the right to use this reserve, except as a road or merely to land on, would undoubtedly be questioned. When fishing becomes a regular industry, I am satisfied that it will be found expedient to have erected, in certain situations, houses or places for which those engaged in the work may make when unable to reach the central stations or their regular homes; and it was to provide for this that I determined on the outposts above mentioned. At the same time, these smaller blocks of land, being contiguous to good fishing-grounds, may become the permanent homes of a few individuals. Along the shores of Queen Charlotte Sound there are already a number of reserves where places of refuge might be erected. I do not, therefore, think it necessary to make any special reservation of land on that score in this part of the district.

In all cases, I think, it is expedient that the reserves should extend from the beach to the top of the range, in order that, under whatever control they may be placed, the officers in charge may prevent the destruction of timber on the higher portion of the hills for the preservation of the water supply.

In the different portions of this report the names given have been taken partly from the Admiralty chart, which I found of great assistance in making the selections. Where no name appears, either on maps or chart, I have taken that in common use in the district.

On the district maps furnished me, which I now return, I have marked, as nearly as I could judge, the frontages of the various reserves proposed, leaving the other lines to be determined whenever a survey is made.

Pelorus Sound.

Regarded as a fishing-ground, the Pelorus Sound may conveniently be divided into three portions—the inland, or the portion south of a line drawn between Tewero and Puaki Points; the central, north of the aforesaid line to East Entry and Danger Points, including Beatrix Bay, Tawhitinui Beach, and Tennyson Inlet; and the seaward portion, extending from East Entry Point outward to the open sea. In the first or inland portion, though fish are plentiful enough for local consumption, they are not sufficiently abundant to warrant the starting of curing establishments. I have therefore selected no land for reservation in this division of the Sound. In the central portion, from the abundance of certain descriptions of fish, such as kahawai, rock-cod, mullet, king-fish, etc., I am satisfied that in time the work of preserving will be found profitable.

I therefore selected two sites—one at Tawa Bay, near the entrance of Tennyson Inlet, where a village community might be established; and another smaller block of land on the northern side of Apuau Channel, knowing it to be an excellent place of shelter in all winds.

It is in the outer or seaward portion that the fishing industry will naturally take its rise, for every description of fish found on this coast can here be had in immense quantities. The large block of level land at the head of Anakoa Bay, forming a natural centre for this portion of the district, should, I consider, be withdrawn from sale until it can be dealt with for special settlement. In connection with this central site I have selected two other sites—one at Orchard Bay, on Forsyth Island, where boats might take refuge in northerly gales; the other an unnamed bay on Kenny Isle, which, though open to the north, is, from some local causes, safe in all weathers.

Tawa Bay.—A well-timbered and well-watered valley, of considerable extent, drains into the head of this bay. The land, though stony, is good, judging by the vegetation. A level beach, of fine firm gravel, on which boats could easily run up, is exposed along the head of the bay at low water. Though open to the

north-west winds, a landing from boats could be safely effected in the north-east corner of the bay. I would advise the reservation of the whole of the valley referred to, taking the watershed as a boundary, and continuing the line to the entrance of the bay.

Apuau.—The configuration of this part of the coast, and the contiguity of Maud Island, make this one of the best places of shelter in the Sound. In the small nooks between the projecting rocky points the water is always still, however rough it may be outside. At the head of each nook is a gravelly beach on which a landing can be effected. The land is of a terrace-like nature, sloping upwards to a steep birch-clad hillside. Round Maud Island and in the channel are well-known fishing-grounds. I have marked on the district map boundaries of land which I consider it advisable to reserve.

Anakoa Bay.—By comparing it with other valleys which have been surveyed in the Sound, I estimate the extent of level and sloping terrace-land at the head of this bay at about 3,000 acres. The whole is heavily timbered, the amount of what is now known as marketable timber being, however, comparatively small, tawa being the predominating tree. About one mile from the extreme head of the bay the terrace-land commences, and this I consider to be the best site for a township, taking the County of Sounds as a whole, and looking forward to the establishment of the fishing industry. The bay in front is a perfectly safe harbour in all weathers, being even now frequently resorted to for shelter by coasters and vessels bound for the Australian ports. There would be no difficulty in connecting Anakoa by a road with the head of the Keneperu Reach, thus bringing the place within easy distance of Picton. Were this done I am satisfied it would become a centre for the fishing-grounds as far as the French Pass and D'Urville Island.

In common with all the large blocks throughout the district, the Anakoa land varies very much in quality. At the place recommended for a township the terrace is stony, but a little farther towards the head of the bay these stones disappear from the surface. Generally, the low land of the valley is very good and well drained. Owing to the narrowness and length of the bay, I do not think the place will suffer during gales from the salt spray, which in this part of the Sound is often found injurious.

Orchard Bay, Forsyth Island.—I selected this site as affording a good shelter or place of refuge from the north-west wind, which is one of the prevailing winds, and blows with great violence. The land here is of a terrace-like nature, but poor and stony. The beach, covered with large rough stones, would be unsafe for boats during southerly weather. There is plenty of

firewood on the ground, and water can easily be procured by sinking, though it is not always to be found on the surface. The map will show the portion I recommend for reservation.

Shelter Cove, Forsyth Bay.—This little bay has so long and frequently been resorted to as a camping-place by fishermen and persons travelling in the Sound that I have given it the name mentioned. It is not marked either on the district map or chart of the Sound. From a small wooded valley or gully at the back a good stream of fresh water runs on to the beach, which is of fine gravel, perfectly safe to run boats on to. I am informed by persons who have frequently visited this bay that even during the north-west gales, to which it is open, no sea of any consequence runs in. I would recommend the reservation of the whole of the little valley following the watershed.

Port Gore.—This inlet, as a fish-producing locality, is exactly similar to the seaward portion of the Pelorus Sound. In it I have selected one block of land for reservation—namely, Melville Cove, at the extreme south-east corner of the inlet.

Melville Cove.—The small, well-timbered, and well-watered valley which drains into the bay opposite the opening of the cove would make a good site either for a curing establishment or for the residence of persons engaged in fishing. The level land of the valley is mostly stony, and has been at one time under cultivation, though now grown up with scrub. The soil on the hillsides is good, large marketable timber growing to a great elevation. The beach at the head of the bay is a coarse gravel, well adapted for landing boats on; it would, however, be subject to a heavy sea during easterly weather. During such weather, however, boats could always run into the northern arm of the cove with safety. Melville Cove could easily be connected by road with Anakoa Valley.

Queen Charlotte Sound.

Here, as in the Pelorus, it is in the outward or seaward portion that any large supply of fish will be obtained; but there is in the inner part of Queen Charlotte Sound a greater abundance of fish than in the corresponding portion of the Pelorus, which I attribute to the absence of large rivers like the Pelorus and Kaituna. To the inner portion of the Sound the town of Picton forms a natural centre of operation; and it is even probable that it may become a central station for the whole Sound, the advantages of postal, telegraph, and steam communication outweighing the cost of transporting the fish from the seaward portion. I have selected two blocks of land for reservation—one at Arrowsmith Bay, Tory Channel; the other in Resolution Inlet. I do not consider either of them suitable sites for curing-establishments, but both of them are well situated and adapted for the homes of persons engaged in fishing.

Arrowsmith Bay.—The land selected along the western shore of the bay, from section No. 87 to the outer point, is a hillside broken into a number of small wooded gullies, from which streams of water flow. Though on a slope, it is not too steep for building purposes, and some of it might be converted into gardens lying well to the sun. The beach in front is safe for boats during all weathers, the island at the mouth of the bay and the bank in the centre, shown on the chart, preventing the sea from rising, however strong the wind. This is a good central situation for fishing in Tory Channel or outside the Heads.

Resolution Bay.—For the large fish obtainable about the mouth of the Sound this inlet is excellently situated. At the mouth of the inlet is a good hapuka ground, and from that down in the direction of Jackson Head and Long Island, these, moki, and other large fish, are in great abundance. The land selected by me at the extreme head of the inlet is a small, well-wooded valley, containing two good streams of water. The land is of a terrace-like nature, well adapted for a small village site. Though the beach is rather exposed to the southerly winds, I do not think there would ever be any danger for boats landing there.

Port Underwood.

As a fishing-ground this inlet differs much from either of the Sounds. The schnapper, plentiful in the Pelorus, but very scarce in Queen Charlotte Sound, is entirely wanting here, as are also kahawai and barracouda; the hauture being the most plentiful fish, frequenting the harbour in immense shoals. Hapuka are also abundant, and moki fairly plentiful. The cray-fish, unknown in the Pelorus, and scarce in Queen Charlotte Sound, is plentiful here.

After careful inquiries, and visiting several bays, I concluded that none of the land now in the hands of the Government is worth reserving for fishing purposes. Every portion of level land on which permanent streams of water exist has passed into private hands. Ocean Bay would have made an excellent fishing-station, but it was sold while Marlborough was still a portion of the Nelson Province. The proprietor of the ground, Mr. M. Aldridge, alive to the importance of having fish-curing established in his part of the district, offers to allow any company or individual desirous of embarking in the industry a site on a mere nominal rent.

JAS. RUTLAND,

Ranger of Crown Lands.

Picton, 20th April, 1885.

The Fisheries Encouragement Act was passed in the year 1885, receiving the support of the main body of the members of both branches of the Legislature. What opposition it encountered was chiefly from those who were opposed to the granting of bonuses on industries generally, or from not apparently grasping the value of our fisheries. How important a part the bonus or bounty system has played in the development of English fisheries needs no pointing out. From the details collected in the foregoing pages, it will be plain that great and manifold, if not unequalled, advantages for fishermen are to be found in the New Zealand waters; while the Fisheries Encouragement Act, affords conclusive evidence of the desire the New Zealand Government displays to foster in all possible ways the establishment of fisheries and fishing villages. There are two prominent features in the Act, to which special attention is directed. One is the bonus on exported canned and preserved fish, and the other the tenure of land on which fishing villages can be established. The conditions of each will be found in the Act itself, in clear and explicit terms. But the bonus does not represent the whole advantage the fish preserver enjoys, as on all potted and preserved fish imported into the Colony a Customs duty of 1d. per lb. is levied; and on fish, dried, pickled or salted, 2s. per cwt. To understand clearly what a market there is for the products of New Zealand canned fish, attention may be directed to our fish imports and exports for the last six years, it being assumed that if we can prepare fish as well and as cheaply here as it can be done in other places and imported, that the home article will drive out the foreign.

IMPORTS OF FISH FOR THE SIX YEARS ENDING 1885.

	DRIED, PICKLED, AND SALTED.			POTTED AND PRESERVED.		
	cwt.	Value £	Duty. 2s. ℔ cwt. £	lb.	Value £	Duty. 1d. ℔ lb. £
1880	2,711	4,935	269	1,187,996	33,668	4,744
1881	3,270	6,278	330	1,193,443	36,422	5,004
1882	3,403	7,013	344	800,112	26,581	3,588
1883	2,756	7,463	290	1,424,542	43,616	6,009
1884	4,533	8,613	470	1,511,262	42,473	5,963
1885	4,419	8,141	441	1,006,830	27,032	4,435
	21,092	£42,443	£2,144	7,124,185	£209,792	£29,743

EXPORTS OF FISH, BRITISH, FOREIGN, AND OTHER COLONIAL, FOR THE SIX YEARS ENDING 1885.

	DRIED, PICKLED, AND SALTED.		POTTED AND PRESERVED.		FROZEN AND FRESH.	
	cwt.	£	lb.	£	cwt.	£
1880	91	132	46,660	1,324	—	—
1881	220	340	67,132	2,139	—	—
1882	173	232	40,460	1,393	—	—
1883	224	312	31,807	1,064	17	24
1884	139	222	22,736	523	155	150
1885	1,380	1,438	76,736	2,082	38	126
	2,227	£2,676	285,531	£8,525	210	£300

EXPORT OF FISH, THE PRODUCE AND MANUFACTURE OF THE COLONY.

	DRIED AND PICKLED.		POTTED AND PRESERVED.		FROZEN AND FRESH.	
	cwt.	£	lb.	£	cwt.	£
1880	16	33	112	3	—	—
1881	27	21	2,240	38	--	—
1882	120	126	—	—	—	—
1883	174	262	2,408	47	17	24
1884	94	138	7,392	111	155	150
1885	1,328	1,337	26,180	640	38	126
	1,759	£1,917	38,332	£839	210	£300

It will be seen from the foregoing tables that we imported in six years fish of the declared value of over a quarter-of-a-million sterling, which, with Customs duties added, and 15 per cent. allowed for profits on sale—little enough, we may depend—would cost the retail purchasers not less than £327,000; or, in other words, the inhabitants of a country, the sea-coasts of which swarm with fish, pay this amount of money away in six years because they are too supine to obtain the fish from the waters belonging to the land in which they dwell. And this amount of fish is nearly all consumed in the Colony, as the quantity exported of that imported (after deducting from the gross exports that cured

or salted in the Colony) only represent in exporters' value some £8,450. Thus we pay away annually for fish, which we could catch and cure ourselves, a sum of money more than sufficient to cover the interest on the loan for what is called the North Island Trunk Railway. It will be also noticed that the pickled and salted fish we import costs us more per cwt. than the declared value of the fish exported—that is, prepared in the Colony.

The table giving the exports, "The Produce and Manufacture of the Colony," is instructive as showing that the year 1885 gave a good promise for the future, if it is an index of a continuous and better state of things. What small amount was sent away was mainly to the Australian Colonies and Fiji, where we may be said to have an almost illimitable market. But the most cheering feature in the export, in 1885, of the New Zealand prepared fish, is found in the fact that its declared value is some three-farthings a pound below that of the foreign article exported to Fiji, for instance, and other markets. The Australian trade must be at least a quarter-of-a-million annually, and is one that will expand faster than the population will increase if the price of the article could command purchasers from the poorer classes of the community. There is not, nor can there be, any valid reason why all this demand should not be supplied from New Zealand if its development were gone properly about. In all human probability the Native owners of Manitoba knew of the great industrial capacities of their country long before they were recognised by Europeans, but their knowledge profited them naught. In just the same manner in the times past have we known of the abundance of fish in our New Zealand seas, but they have been to us but little more than a theme for laudation.

The settlement intent of the Fisheries Encouragement Act can be easily summarised. Free lands for homesteads and free fishing for fishermen and their descendants, who continue fisher folk from generation to generation. The tenure is that of the Crown, and free from the caprice of individuals. The title to possession can only be changed or destroyed by revolution. The homesteads can neither be sold nor mortgaged. Herein is found, perhaps, the chief excellence of all landed possession. The holders are free from rent and the fear of eviction. There is no landlord, present or prospective, other than the impersonal Crown. The land is free for ever, and the sea swarms with fish. Both are open to the men of all nations.

List of Fishes of New Zealand.

Class I.—PALAEICHTHYES.

Order I.—CHONDROPTERYGII.

Sub-Order I.—PLAGIOSTOMATA.

CARCHARIIDÆ.

Carcharias	.. *brachyurus*	.. Günther	.. Blue shark, or Tuatini
Zygæna	.. *malleus*	.. Risso	.. Hammer-headed shark, or Mango-pare
Mustelus	.. *antarcticus*	.. Günther	.. Smooth hound
Galeus	.. *canis* ..	.. Günther	.. Tope

LAMNIDÆ.

Lamna	.. *glauca*	.. Mull. & Henle	Mako, or Tiger shark
,,	.. *cornubica*	.. L.	.. Porbeagle
Carcharodon	.. *Rondeletti*	.. Mull.	.. White shark
Alopecias	.. *vulpes*	.. Gml.	.. Thresher
Selachus	.. *maximus*	.. L.	.. Basking shark

NOTIDANIDÆ.

Notidanus	.. *indicus*	.. Cuv.	.. Perlon

SCYLLIIDÆ.

Scyllium	.. *laticeps*	.. Dumeril	.. Dog-fish, or Mango-reremai

CESTRACIONTIDÆ.

Cestracion	.. *Philippi*	.. Lacep.	.. Port Jackson shark

SPINACIDÆ.

Acanthias	.. *vulgaris*	.. Risso	.. Spined dog-fish
Echinorhinus	.. *spinosus*	.. L.	Spinous shark
Scymnus	.. *Lichia*	.. Cuv.	

Batoidei (Rays).

Rhinobatus ..	*Banksii* ..	Mull. & Henle	
Trygonorhina ..	*fasciata* ..	,,	The Fiddler
Torpedo ..	*Fairchildi* ..	Hutton	
,, ..	*fusca*	Parker	Electric Ray
Raja	*nasuta* ..	Soland. ..	Skate, or Whai
Trygon ..	*Thalassia* ..	Columna ..	Stingaree, or Wairepo
,, ..	*Kuhlii* ..	Mull. & Henle	
,, ..	*brevicaudata* ..	Hutton	
Myliobatis ..	*aquila* ..	L. ..	Whip Ray
,, ..	*tenuicaudatus*	Hector	

Sub-Order II.—HOLOCEPHALA.

Callorhynchus ..	*antarcticus* ..	Lacep. ..	Elephant-fish, or Repe-repe

Class II.—TELEOSTEI.

Order I.—ACANTHOPTERYGII.

Percidæ.

Plectropoma ..	*Huntii* ..	Hector	
Oligorus ..	*gigas*	Owen ..	Hapuku, or Groper
Arripis ..	*salar*	Rich. ..	Kahawai
Erythrichthys ..	*nitidus* ..	Rich.	
Anthias ..	*Richardsoni* ..	Günther ..	Red Schnapper, or Maratea
Therapon ..	*rubiginosus* ..	Hutton	

Squamipinnes.

Scorpis ..	*Fairchildi* ..	Hector ..	Mata
Atypus ..	*strigatus* ..	Günther	

Mullidæ.

Upeneoides ..	*vlamingii* ..	C. and V. ..	Red Mullet, or Pakurakura
Upeneichthys ..	*porosus* ..	C. and V.	

Sparidæ.

Girella ..	*simplex* ..	Rich. ..	Black Perch
Haplodactylus ..	*Donaldi* ..	Haast	
,,	*meandratus* ..	B. and S. ..	Granite Trout, or Kehei
Pagrus ..	*unicolor* ..	Quoy & Gaim.	Schnapper, or Tamure

CIRRHITIDÆ.

Chironemus	.. *Georgianus*	.. C. and V.	
,,	.. *Fergussonii*	.. Hector	.. Hiwihiwi
Chilodactylus	.. *carponemus*	.. Parkinson	
,,	.. *macropterus*	.. Forst.	.. Tarakihi
,,	.. *spectabilis*	.. Hutton	.. Nanua, or Ehouhou-namu
,,	.. *Douglasi*	.. Hector	.. Porae
Mendosoma	.. *lineata*	.. Forst.	
Latris ..	.. *hecateia*	.. Rich.	.. Trumpeter, or Kohi-kohi
,, ..	.. *cilaris*	.. Forst.	.. Moki
,, ..	.. *ærosa*	.. Hutton	

SCORPÆNIDÆ.

Sebastes	.. *percoides*	.. Solander	.. Sea Perch, or Pohui-karoa
Scorpæna	.. *cruenta*	.. Solander	
,,	.. *barathii*	.. Hector	
,,	.. *bynoensis*	.. Rich.	
Agriopus	.. *leucopoecilus*	.. Rich.	.. Pig-fish
Prosopodasys	.. *cottoides*	.. L.	

BERYCIDÆ.

Trachichthys	.. *elongatus*	.. Günther	
,,	.. *intermedius*	.. Hector	
,,	.. *Trailli*	.. Hutton	
Beryx ..	.. *affinis*	.. Günther	.. Nannygai

XIPHIIDÆ.

Histiophorus	.. *Herschelli*	.. Gray	
Xiphius	.. *gladius*	.. L.	Sword-fish, or Paea

TRICHIURIDÆ.

Lepidopus	.. *caudatus*	.. Euphrasen	.. Frost-fish, Hiku, or Para
,,	.. *elongatus*	.. Clarke	
Thyrsites	.. *atun* ..	.. Euphrasen	.. Barracouda, or Manga
,,	.. *Prometheus*	.. Webb	

ACRONURIDÆ.

Acanthurus	.. *triostegus*	.. L.	

CARANGIDÆ.

Trachurus	.. *trachurus*	.. L.	.. Horse Mackerel, or Hauture
Caranx	.. *Georgianus*	.. C. and V.	.. Trevalli, or Arara

Caranx	*Koheru*	Hector	Herring-scad, or Koheru
Seriola	*lalandii*	C. and V.	King-fish, or Haku
Seriola	*porosa*	Guich.	
Naucrates	*ductor*	L.	Pilot-fish

CYTTIDÆ.

Zeus	*faber*	L.	John Dory, or Kuparu
,,	*novæ zealandiæ*	Arthur	
Cyttus	*australis*	Rich.	Boar-fish
,,	*Traversi*	Hutton	
,,	*abbreviatus*	Hector	

CORYPHÆNIDÆ.

Lampris	*luna*	Risso	
Brama	*squamosa*	Hutton	

NOMEIDÆ.

Gasterochisma	*melampus*	Rich.	Butterfly-fish
Neptonemus	*brama*	Günther	Warehou, or Sea-bream
,,	*bilineatus*	Hutton	
Platystethus	*abbreviatus*	Hector	
,,	*Huttoni*	Günther	
Ditrema	*violacea*	Hutton	Maomao.

SCOMBERIDÆ.

Scomber	*australasicus*	C. and V.	Mackerel, or Tawatawa
Discus	*aureus*	Camp.	
Pelamys	*chilensis*	C. and V.	Tunny

TRACHINIDÆ.

Kathetostoma	*monopterygium*	Bleeker	Cat-fish, Hard-head, or Ngu
,,	*maculosa*	Solander	
,,	*læve*	Bleeker	
,,	*fluviatilis*	Hutton	
,,	*giganteum*	Haast	
Leptoscopus	*macropygus*	Rich.	
,,	*angusticeps*	Hutton	
,,	*Huttoni*	Haast	
,,	*Robsoni*	Hector	
Percis	*colias*	Forst.	Rock-cod, or Pakirikiri
Bovichthys	*variegatus*	Rich.	
Notothenia	*coriiceps*	Rich.	Flat-head, or Maori Chief
,,	*angustata*	Hutton	

Notothenia	.. *microlepidota*	Hutton	.. Black Cod
,,	.. *parva*	.. Hutton	
,,	.. *cornucola*	.. Rich.	
Cheimarrichthys	*Fosteri*	.. Haast	

PSYCHROLUTIDÆ.

Neophrynichthys	.. *latus* ..	.. Günther	.. Toad-fish

PEDICULATI.

Saccarius	.. *lineatus*	.. Günther	
Ægæonichthys	*appelli*	.. Clarke	

COTTIDÆ.

Trigla	.. *kuma*	.. Less. & Garn.	Gurnard, or Kumukumu
Lepidotrigla	.. *brachyoptera*	.. Hutton	

GOBIIDÆ.

Gobius	.. *lentiginosus*	.. Rich.	
,,	.. *amiciensis*	.. C. and V.	
Eleotris	.. *gobioides*	.. C. and V.	.. Bull-head, or Hawai
,,	.. *radiata*	.. Quoy	Kurahina

TRICHONOTIDÆ.

Hemerocœtes	.. *acanthorhynchus*	.. Forst.	

BLENNIIDÆ.

Clinus	.. *rubrum*	.. Hutton	
,,	.. *flavescens*	.. Hutton	
Trypterygium	*nigripenne*	.. C. and V.	
,,	.. *Forsteri*	.. C. and V.	
,,	.. *Jenningsi*	.. Hutton	
,,	.. *fenestratum*	.. Forst.	
,,	.. *medium*	.. Günther	
,,	.. *compressum*	.. Hutton	
,,	.. *varium*	.. Forst.	
,,	.. *dorsalis*	.. Clarke	
,,	.. *decemdigitatum*	Clarke	
,,	.. *robustum*	.. Clarke	
Cristiceps	.. *australis*	.. C. & V.	

ACANTHOCLINIDÆ.

Acanthoclinus	*littoreus*	.. Forst.	
,,	.. *taumaka*	.. Clarke	

SPHYRÆNIDÆ.

Sphyræna	.. *obtusata*	.. C. and V.	

ATHERINIDÆ.

Atherina	.. *pinguis*	.. Lacep.	

MUGILIDÆ.

Mugil	.. *Perusii*	.. C. and V.	.. Mullet, or Kanæ
Agonostoma	.. *Forsteri*	.. Bl.	.. Sea Mullet, Makawhiti, or Aua

FISTULARIDÆ.

Fistularia	.. *serrata*	.. C. and V.	

CENTRISCIDÆ.

Centriscus	.. *humerosus*	.. Rich.	.. Snipe-fish

GOBIESOCIDÆ.

Diplocrepis	.. *puniceus*	.. Rich.	.. Sucker
Trachelochismus	.. *pinnulatus*	.. Forst.	
,,	.. *guttulatus*	.. Hutton	
Crepidogaster	*Hectori*	.. Günther	

TRACHYPTERIDÆ.

Trachypterus	*altivelis*	.. Kner.	
,,	.. *arawata*	.. Clarke	
Regalecus	.. *gladius*	.. Walb.	.. Oar-fish
,,	.. *pacificus*	.. Haast	
,,	.. *argenteus*	.. Parker	.. Ribbon-fish, or Matarua

NOTACANTHI.

Notacanthus	.. *sexspinis*	.. Rich.	

Order II.—ACANTHOPTERYGII PHARYNGOGNATHI.

POMACENTRIDÆ.

Dascyllus	.. *aruanus*	.. L.	

LABRIDÆ.

Ctenolabrus	.. *Knoxi*	.. Hutton	.. Muritea
Labrichthys	.. *celidota*	.. Forst.	.. Sea Perch
,,	.. *bothryocosmus*	.. Rich.	.. Wrasse
,,	.. *psittacula*	.. Rich.	.. Parrot-fish
,,	.. *fucicola*	.. Rich.	

Labrichthys	.. *laticlavius*	.. Rich.	
,,	.. *cincta*	.. Hutton.	
Odax	.. *vittatus*	.. Sol.	.. Kelp-fish
Coridodax	.. *pullus*	.. Forster	.. Butter-fish, or Marare
Cossyphus	.. *unimaculatus*	.. Günther	
Cymulutes	.. *Sandegeri*	.. Hector	

ORDER III.—ANACANTHINI.

ANACANTHINI GADOIDEI.

Gadidæ.

Gadus	.. *australis*	.. Hutton	.. Haddock
Halargyreus	.. *Johnsonii*	.. Günther	
Lotella	.. *rhacinus*	.. Forst.	.. Hake
,,	.. *bacchus*	.. Forst.	.. Red Cod
Pseudophycis	.. *breviusculus*	.. Forst.	
Merluccius	.. *Grayi*	.. Günther	
Motella	.. *novæ zealandiæ*	Hector	
Bregmaceros	.. *Maclallandii*	.. Günther	
Calloptilum	.. *punctatum*	.. Hutton	.. Ahuruhuru

Ophidiidæ.

Genypterus	.. *blacodes*	.. Forst.	.. Ling, or Rari
Dinematichthys	*consobrinus*	.. Hutton.	

Macruridæ.

Macrurus	.. *australis*	.. Rich.	
,,	.. *armatus*	.. Hector	
Coryphænoides	*novæ zealandiæ*	Hector	.. Hoki, or Okarari
,,	.. *denticulatus*	.. Rich.	

ANACANTHINI PLEURONECTOIDEI.

Pleuronectidæ.

Brachypleura	*novæ zealandiæ*	Günther	
Pseudorhombus	*scaphus*	.. Forst.	Brill
,,	.. *boops*	.. Hector.	
Ammotretis	.. *Guntheri*	.. Hutton	
,,	.. *rostratus*	.. Günther	Lemon Sole
Rhombosolea	.. *monopus*	.. Günther	.. Patiki, or Flounder
,,	.. *leporina*	.. Günther	Yellow-belly
,,	.. *tapirina*	.. Günther	
Peltorhamphus	*novæ zealandiæ*	Günther	.. Sole
Bowenia	.. *novæ zealandiæ*	Haast	

Order IV.—PHYSOSTOMI.

SCOPELIDÆ.

Scopelus	.. *parvimanus*	.. Günther	
,,	.. *boops*	.. Rich.	
,,	.. *coruscans*	.. Rich.	
,,	.. *Hectori*	.. Günther	
Gonostoma (Maurolicus)	*australis*	.. Hector	

SCOMBRESOCIDÆ.

Scombresox ..	*Forsteri*	.. C. and V.	.. Skipper
Hemiramphus	*intermedius*	.. Cant.	.. Gar-fish, or Heihe
Arrhamphus ..	*sclerolepis*	.. Günther	
Exocœtus	.. *micropterus*	.. C. and V.	
,,	.. *speculiger*	.. C. and V.	.. Flying-fish, or Maroro

GALAXIDÆ.

Galaxias	.. *alepidotus*	.. Forst.	
,,	.. *fasciatus*	.. Gray	.. Kokopu, or Hipara
,,	.. *olidus*	.. Günther	
,,	.. *brevipinnis*	.. Günther	.. Gudgeon
,,	.. *attenuatus*	.. Jenyns	.. Minnow
Neochanna	.. *apoda*	.. Günther	.. Mud-fish

STERNOPTYCHIDÆ.

Phosichthys ..	*argenteus*	.. Hutton	
Argyropelecus	*intermedius*	.. Clarke	

SALMONIDÆ.

Retropinna	.. *Richardsoni*	.. Gill	.. Smelt
Argentina	.. *decagon*	.. Clarke	

HAPLOCHITONIDÆ.

Prototroctes ..	*oxyrhynchus*	.. Günther	.. Grayling, ~~or~~ Upokororo

GONORHYNCHIDÆ.

Gonorhynchus	*Greyi*	.. Rich.	.. Sand-eel

CLUPEIDÆ.

Engraulis	.. *encrasicholus*	.. L.	.. Anchovy, or Korowhawha
Clupea	.. *sagax*	.. Jenyns	.. Pilchard, or Sardine

Clupea	.. *sprattus*	.. L.	.. Sprat, or Kupai
Chanos	.. *salmoneus*	.. Forst.	.. Herring

MURÆNIDÆ.

Anguilla	.. *aucklandii*	.. Rich.	.. Eel Tuna
,,	.. *latirostris*	.. Risso	
,,	.. *australis*	.. Rich.	
Conger	.. *vulgaris*	.. Cuv.	.. Conger Eel, or Ngoio
Congromuræna	*habentata*	.. Rich.	.. Silver Eel
Ophichthys	.. *serpens*	.. L.	
Muræna	.. *krulli*	.. Hector	

Order V.—LOPHOBRANCHII.

SYNGNATHIDÆ.

Syngnathus	.. *pelagicus*	.. L.	
,,	.. *blainvillianus*	Gerard	
Doryichthys	.. *elevatus*	.. Hutton	
Ichthyocampus	*filum*	.. Günther	.. Pipe-fish
Stigmatophora	*longirostris* ..	Hutton	
Solenognathus ..	*spinosissimus*	Günther	
Hippocampus ..	*abdominalis* ..	Less.	.. Sea-horse

Order VI.—PLECTOGNATHI.

SCLERODERMI.

Monacanthus ..	*convexirostris*	Günther	.. Leather-jacket, or Kiriri
Ostracion	.. *fornasini*	.. Branc.	.. Trunk-fish

GYMNODONTES.

Tetradon	.. *Richei*	.. Fremino	.. Globe-fish
Chilomycterus ..	*jaculiferus*	.. Cuv.	.. Porcupine-fish, or Kopuwai-totara
Orthagoriscus ..	*truncatus*	.. Lacep.	.. Sun-fish

Class III.—CYCLOSTOMATA.

PETROMYRONTIDÆ.

Geotria	.. *chilensis*	.. Gray	.. Lamprey, Piharau or Puhikorokoro
,,	.. *australis*	.. Gray	

MYXINIDÆ.

Bdellostoma ..	*cirrhatum* ..	Forst.	.. Hag.

Class IV.—LEPTOCARDII.

CIRROSTOMI.

Branchiostoma	*lanceolatum* ..	Yarrell	.. Lancelet.

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WILSON AND HORTON. "HERALD" PRINTING WORKS, AUCKLAND.